AN OGDEN PUBLICATION DEVOTED TO GLASS TECHNOLOGY, ENGINEERING, MATERIALS AND GLASS FACTORY EQUIPMENT AND OPERATION

the glass industry

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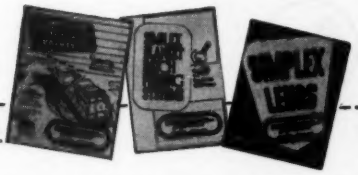

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the glass industry
VOLUME 36, NUMBER 8, AUGUST, 1955

International Glass Events

Howard Lillie Elected Vice President, International Commission—Commission Sets International Congress, Paris, July 2-6, 1956—Scientific Continental Union Holds International Symposium On Glass Fining

By N. J. KREIDL, Chemical Research Director
Bausch & Lomb Company, Rochester, New York

COMMISSION AND CONGRESS

New Commission Vice President. Howard Lillie was elected Vice President of the International Commission on Glass at its meeting in Wuerzburg, Germany, 16-19 June 1955. The move strengthens the policy of continuous and close cooperation between American and European glassmen advocated by this writer after the 1952 meeting and implemented by the American Ceramic Society through the new Standing Committee of the Glass Division on Commission affairs. Howard Lillie succeeds B. Long, France.

Commission at Work. The Commission evaluates and distributes among glassmen standards and standard procedures on glass, is concerned with all international activities including publications on glass, and should represent the forum of discussion among men of all nationalities. In particular it is to organize about every three years as International Congress on Glass.

The United States is represented in the Commission through the corporate membership of the American Ceramic Society. The individual representatives now are: O. Burch (acting for the President) ex-officio; F. Tooley (acting for the Secretary) ex-officio; H. Lillie, also Executive Committee member, elected 1952-56; N. Kreidl, elected 1954-57; G. Morey, honorary member.

The Congress of Venice in 1953, the first to convene after the pre-war Congress of London in 1936, was a brilliant success. The comprehensive volume of the Proceedings of this Congress surprised many people who, after the forced separation of years, had almost forgotten what, and how much, was accomplished abroad and by whom it was accomplished. Many of us, however, concurred that a certain tendency, perhaps natural after so long an intermission, towards quantity and mulitiplicity should not continue.

Therefore, the Commission gave much thought to a new policy for the next Congress. In this endeavor it engaged in enough controversy to justify, it was said, the generous gift to its members by their German colleagues of a special thermometer reading up to the boiling point.

Paris Congress Offers New Style. In 1956, the Paris Congress will attempt to stress discussion, quality at a level commensurate with a good marriage between practice and theory over lecture, quantity and long hair specialization. It will do so by the use of the following novel and experimental procedures: (1) No simultaneous sessions; (2) Technical sessions not longer than 2 hours; (3) Limitation to 35 oral contributions, using method (4). (4) Syntheses of related papers presented by one speaker for group of authors. (5) Favoring invited reviews. (6) Acceptance only of papers available as complete manuscripts in Paris by March 1956. (7) Inducement of authors to speak, illustrating theoretical theses with practical implications, having in mind an audience of mixed interests, in part practical.

The organization of the Congress will be as follows: *President:* A. Delloye, French Industrial Leader; *Working Committee:* Dameron, Long, Peyches, all of Paris (this Committee is to be credited with the initiative on the new thoughts to be implemented in this Congress); *National Committees:* USA: The Glass Division's Advisory Committee on Commission Affairs will serve in this function. It consists of H. Lillie (Chairman), N. Kreidl, F. Fling, J. Gregorius. This Committee will accept and invite contributions on behalf of the Commission.

New Constitution. The Commission completed the revision of its constitution. In a compromise with the USA, the rule permitting no substitution in the Executive Committee was modified by allowing the President to approve substitutes "if he deems the work of the Commission so furthered." This reporter was able to argue two of our viewpoints because the President so ruled. In one case, the National Committee was delegated Congress responsibilities. The other case referred to the controversial issue of an International Journal.

The Commission made the firm decision not to subsidize its journal, the "*Proceedings of the International Commission on Glass.*" American representatives have not favored the start of another publication on glass and have just tolerated a charter which precludes the competitive status its commercial publishers might have considered essential. For this reason we maintained an attitude which makes it clear that the *Proceedings* must find a reason to exist outside the sphere in which well-established American and, we should think, also foreign journals now function; and to do so without Commission membership dues involved.

The main diversion of those attending the Commission meeting was the visit to Dr. A. Dietzel's Institute of Silicate Research. This is the successor of the Kaiser Wilhelm Institute in Berlin and was created, in 1952, from a World War I Officer's Club. The splendid work and equipment seen there was alone worth a trip from far away.

The German Society arranged for good times on and off the program. We increasingly like the laudable restraint on speechmaking and "fun" once we are east of the seas. Formalities were few at the banquet given in Bad Kissingen by the Manufacturers Association; and a Mozart concert in the 18th century residence of the ecclesiastic rulers of Wuerzburg was followed by a congenial reception in the old fortress towering over the city. The Mayor briefly welcomed the group and there was much Franconian wine on the medieval premises. The gem of medieval Germany, Rothenburg, was visited by special train.

The Commission was next invited to attend the Scientific Continental Union's Symposium on Glass Fining in Paris, and certain airplanes were filled with vitreous conversation.

SYMPOSIUM ON FINING

The list of papers and the resume on the contributions and discussions on the one topic this reporter covered will testify to a very high level and successful piece of cooperative work on glass technology.

The writer has submitted to our own Glass Division Symposium Subcommittee for study the suggestions and directives which have made this International Symposium quite different from the conventional affair. An outline follows.

First Day: Three working groups organized: I. Methods, II. Technology, III. General Theory under president—"animators." II. Guenther, Germany. III. Kreidl, USA, each having two real work horses, the "reporters." III. Kantzer, France, Plumat, Belgium and they meet separately, hearing the papers and having their "animators" animate animated discussions.

All papers—and this is due to the charming insistence and organizational talent of the Scientific Continental Union's Secretary H. Vandecapelle—were available in enough copies for everybody at the start of the meeting. Everybody joined the audience of the working group of his preference. The reporters took careful notes.

Second Day: 6 work horses (reporters) work all day to produce 3 one-hour reports for the third day. Everybody else, including your animator, took the day off for plant tours, Atomic Energy installations or "plain" Paris.

Third Day: Full assembly. Each team presents his report for discussion after a background story prepared by the German colleagues was examined. The animators preside one after the other and extract and squeeze everything and everybody, chiefly in French.

Post Mortem: The six reporters now write a monograph on Glass Fining which will be worthwhile digesting.

The Papers

(a) Methodology:

P. Angenot, Contribution to the Study of Bubbles Drawn in the Libbey-Owens Process; R. Bastick, Laboratory Experiments on the Refining of Glass; E. De Geyndt, Removal and Analysis of Bubbles by a Simple Microburette; E. De Geyndt, Bubbles from Iron; W. & S. Kruszewski, Examination of Bubbles and Blisters in Glassware; T. Okamura, T. Uno et T. Uekawa, Gases Contained in Glass in Refining Process; E. Plumat & M. Jaupain, Method of Examination of the Liberation of Bubbles in Contact with Refractories; W. Price, The Analysis of the Gases Occurring in Bubbles and in Solution in Glass; L. Prod'homee, Method of Observation of Bubbles by Diffusion; S. C. Rademaker, Some Experiments On the Analysis of Glass Bubbles by Classical Methods.

(b) Technology: C. F. Cala, Seeds and Fining in Optical Glass Manufacture; L. Dubrul, Graphical Representation of the Progress of Fining; Y. Godron & S. de Lajarte, Relation between Fining Quality and Experimental Working Conditions; M. Jaupain, Comparison of Some Fining Agents; M. Masuda, A Consideration of Refining of Sheet Glass; L. Penberthy, Refining by Vaporizable Batch Ingredients in All-electric Day Tanks; I. Sawai, K. Takahaski and H. Jinno, Studies on Glass Tank Furnace: III Roll of the Convection Currents; D. Scagnelli, Kinetics of the Chemical Reactions in Melting, in Relation to the Abnormal Presence of Gases Liberated during Fining; A. Tardieu, Influence of the Time Factor in Glass Fining; J. Widtmann, Fining by the Introduction of Gases into the Melt.

(c) General Theories: R. K. Day, Bubbles in Glass. The Problem and Some Approaches to its Solution; W. Geffcken, The Process of Bursting of Bubbles; F. J. Grove, Water in Glass; J. Koranyi, Distribution of Bubble Diameters in Glass during Refining Period of Melt; L. Leger, Experiments on the Solubility of Gases in Glass; F. Mahieux, Genesis and Evolution of Gases in Glass; E. Plumat, Physicochemical Processes of Bubble Formation in Contact With Several Refractory Types; G. E. Rindone, Possible Explanation for Gas Evolution after Fining in Barium Glasses containing Sulfates; J. W. Tomlinson, Note on the Solubility of Water in a Molten Sodium Silicate.

Resume on General Theories. Following is a brief summary of the summary report of Messrs. Kantzer and Plumat on the general theories session.

Problems fundamental to the fining process are: the solution and exsolution of various gases in glass, the formation of gas bubbles from glass-refractory interactions, the formation of bubbles from nuclei, the rise and burst of the bubble. The physics of rising bubbles was considered well covered in previous work and not considered at this meeting.

Solubility. Mahieux, Grove and Tomlinson extracted gas under vacuum at high temperature and analyzed it. The 2.8 μ (infrared) band was utilized for the determination of water (protons) in glass by Grove, tracer methods by Mahieux.

An increase in cations (Na, Ca) sharply increases the solution of SO_3 and CO_2 (Mahieux). The water content increases proportionally with pressure (Tomlinson), and was determined as well as varied at will by Grove who bubbled glass with dry air, steam and air of known water contents.

The surface tension of glass decreases substantially in the presence of water vapor. Bubbly glass cleared rapidly when the water vapor above it was diluted with air; water vapor from bubbles is easily redissolved in glass (Leger).

The fixation of SO_2 in glass and the SO_2, O_2, SO_3 equilibria were investigated and discussed in detail, as was the fixation of CO_2 and, to lesser extent, of hydrogen (Leger, Mahieux).

SO_2 fixation, e.g., goes through a maximum at 700-500°C. (compromise of Na mobility, and SO_2-SO_3 equilibrium) ceasing at about 1000°C., rising again from 1100°C., when the viscosity of the glass permits participation of the bulk in the reaction.

This investigation suggests, too, that the role of sodium sulfate as a fining agent includes, above 1000°C., the dissociation of SO_3 and deplacing the equilibrium towards fixation of CO_2. On cooling, however, one risks reappearance of CO_2 (reboil).

Leger associates the diffusion of hydrogen (also chlorine) out of the glass with alkali losses, provoking Stevels suggestion to look for color centers in glasses so handled and subsequently irradiated.

Bubble Formation. The meeting followed with R. Day (THE GLASS INDUSTRY, July 1955) admitting that bubbles could not form except if nucleated at some heterogeneity. The refractory is always here. However, there was some controversy as to whether a bubble had ever been seen originating within the glass, say in a piece of cullet. Those who think so must assume some heterogeneities in the very structure of the "real" glass. The small temperature coefficient of the solution of H_2O in glass is indicative of the role here played by weaker hydroxy bonds. Devitrification, or something just below the definite level of devitrification, was accepted as a potential source for bubble formation.

Rindone, at Penn State, has separated barium glasses into two phases, one prone to crystallization on cooling, when a composition that contained sulfur and sodium was poured into one containing no sulfur and potassium. The K^+ ions migrate preferentially to the SO_4^{2+} anions; the initiation of a similar process was suggested as one possible mechanism of nucleation of bubbles in barium crowns.

In the bubble-glass discussion, this reviewer found of interest that dry air injected into glass favors the migration of water and its precipitation (Grove).

Gases from Outside. Plumat presented an exhaustive study of reactions of glass with solids (carbon, sulfur, sulfates, oxides, particularly also that of iron). This study will deserve much attention when published. The equilibria of such substances with glass have tremendous importance for the behavior of refractories contaminated with such substances. In this respect, the elimination of sulfates from refractories by preheating came up.

The most spectacular demonstration of these reactions is given by the case of TiO_2. The oxide gives off oxygen, the glass becomes pink, the yellow refractory turns bluish. The alkali of the glass moving into the refractory starts off the reaction, described in terms of Weyl's screening theory. Plumat, from brilliantly exposed examples, generalizes speculatively that some SiO_2 may even be reduced in this process, explaining the general occurrence of bubbles at even pure SiO_2-Al_2O_3 refractory glass interfaces.

Burst, Fining Agents. Germany took care of the burst of the bubble and the effect of fining agents. Geffken (Schott, West Germany) gives a thorough analysis of the physics of the bursting bubble; Schoenborn (Schott, East Germany) describes the role of antimony as a fining agent. His colleagues, representing his work, were the only people from the other side of the curtain. However, even here we saw the "door ajar." In the discussion, the recommendation of "wet" batches has not lost its old appeal.

RANDOM OBSERVATIONS

Paris was as hospitable as ever. France has no glass society. In the Commission she is represented through institutions; in this splendid effort, through volunteers. They deserve a bravissimo. Ideas stemmed from B. Long, Chairman (all the work), I. Peyches "general reporter" (all the work once again). Their staff was well selected and efficient. Food and wine at events crowded out the spoken word (bravissimo).

Europe was found in a surge of prosperity. Not just much better than two years ago, but in a surge of a true business prosperity. Madrid, Vienna, Wuerzburg and Paris visited. The building industries were found at record activities in most countries. Undoubtedly American aid has contributed immeasurably to this resurgence.

The building industries carry along Europe's glass industries in this boom. A glass scientist is just a tourist who does not see much more than the sights lined along his fortuitous path. However, the status of European industry becomes impressive. The optical glass methods of the American industry, with which this writer is familiar, are becoming common knowledge. The artificial positive and negative handicaps of the war are vanishing. American processes are licensed to Europe and American concerns manufacture in Europe. European engineers match ideas and processes at increasing pace.

Spain is included in the boom. Her striated social system cannot fast adjust to the new pace of progress. However, her economy moves. Madrid is now one of the finest cities of Europe; more uniformly elegant, attractive and modern perhaps than any of the capitals of the countries engaged in the last war. There is a resemblance to New York in Madrid. Her houses rise high over those of the older capitals; her wealthier and downtown crowds have hamburgers, french fries and milk shakes at fabulous prices in shining soda fountain

stores which dispense cocktails too. Spanish pride professes forgiveness of our unawareness of East-West problems around 1945; restrained appreciation of our recent aid and assertion of the Spanish contribution. Expression is free, as it will always be in Latin countries, and the authoritative structure, induced by the low national income at least as much as by arbitrary decision, is much more complex than in the European dictatorships to which it may erroneously be likened at a distance. The Research Centers and the University City are imposing in layout, style and initial performance.

In Vienna, the Russian change of policies is not just carried out, but emphatically advertised. The Colonel of an evacuating regiment requests the local baron's permission for the additional three days an officer may have to linger. Within weeks, nearly all Austrians returned from Siberia; whether they were victims of error, arbitrariness or crime, no questions asked. We recall a man of 23, then a boy of 13, and a man unfortunately named Eisenhauer. The return of the 20% of the major industries that have been owned by the Russian government to Austrian ownership shakes the economic world of the small country. The conservative socialist coalition government has agreed that a large portion will become private enterprise and more as well as less legitimate interests, including the external weight of Germany, are felt to move into this large vacuum. This poorest of all European countries is included in the boom; her 7,000,000 people will see a $150,000,000 building program financed almost entirely inside during 1955.

The prosperity in Germany is largest. German exports and, again, some export methods, are watched with some concern in other countries. Motorization has taken on some American modernization. Parking meters and city loops have entered the picture. The Wuerzburg meeting offered the occasion of informal talks with travellers from the East. The gradient of every day life across the now half open boundary has steepened, and as the curtain appears to be somewhat raised, information on the detailed impact of this gradient is rather general. This appears to cause a true thermodynamic instability of which the present Eastern policies must have taken careful inventory. In this sense, they seem quite sincere to this traveller.

Prosperity in general has affected capitalization and employment more than wage levels. In Spain, a change from $.65 to $1.10 minimum a day is under discussion. However, the pulse of economy has become accelerated and wage movements to be successful had to wait a cue. British strikes in this sense are more a sign of health now than of crisis. In Germany, the joint labor-management attitudes versus reconstruction are stronger than the public political rift implies and bear watching by the countries interested in competitive world trade. A round of wage increases may seem more indicated than the traditional stress of national effort toward large export markets, although the exact measure is hard to find.

This writer came home with more optimism. Action and achievement have done more than words and plans. It is never useless when men who are not neighbors meet face to face. The glassmen have the tradition of long friendships across the borders and share the joint enthusiasm of their hot trade. The corn and hog people may make a start. All of the statesmen may yet follow suit.

LIBBEY-OWENS-FORD ANNOUNCES LARGEST CONSTRUCTION PROGRAM

Rapid progress is being made by Libbey-Owens-Ford Glass Company on the largest construction program to increase capacity for making plate glass ever started by the company. The multi-million-dollar project is the engineering and production answer to the rapidly growing demand for plate glass, both in building and automotive markets, according to the announcement.

The drive to increase glassmaking capacity follows closely the completion of the three-year construction program at the Rossford factory. The current L-O-F expansion program includes installation of additional twin-grinding equipment and accessories at Rossford.

Work started early this year on the foundations for two new 1100-ton glass melting tank furnaces at the East Toledo plant, and this work is being pushed ahead of schedule by the A. Bentley & Sons Company, general contractors. Along with the two new tanks, there will be annealing lehrs, a large glass storage facility and raw material batch storage.

Another large segment of the new construction at the East Toledo plant is a new grinding and polishing line on the location of the former No. 1 line, which historically was the basis for construction of the plant in 1924. Completion of the new Toledo grinding and polishing line is scheduled for late 1955, and the tanks and accessory structures in early 1956.

On completion, the new units will provide jobs for about 1200 additional employees, it was estimated by Curtis W. Davis, Executive Vice President-Production.

OVERMYER IRON CLINIC TO BE HELD IN SEPTEMBER

Announcement of the 7th Annual Overmyer Iron Clinic has been made and it is scheduled to be held on Thursday, September 22.

Although details of the program are not available, an outline of activities is. The Clinic will begin at 8:00 a.m. with registration at the Main Office of Overmyer. From there, tours will be conducted through the Foundry and Mold Division. The business session will begin at 9:30 a.m., which will include discussions on Sonic cleaning and polishing of mold equipment. There will also be considerable information available regarding the Lubracrome process. This process has been installed at Overmyer Mould Company and Overmyer's experience with it during the past year will be discussed. The Colmonoy process will also be under discussion.

Following noon luncheon, the usual golf tournament will get underway, followed by the evening cocktail party and banquet at 7:00 p.m.

One of the features of the Clinic this year will be the first showing of a color movie which follows the production of a mold from a raw casting to the glass factory. The film is entitled "The Birth of a Bottle," and is believed to be the first time such a film has been presented on this phase of glass production.

Hydrazine — Its Use In Mirror Making

By SAMUEL WEIN

Introduction

Hydrazine and its compounds are used as a reducing agent in mirror making. A survey among practical mirror makers by the author indicates (1) that it is considered a new development and (2) its use is not fully recognized because collective information is not available. It is the purpose of the present paper to show that (1) the use of hydrazine as a reducing agent specifically for mirror making is by no means new as is evidenced by the chronological survey of the patent and technical literature and (2) to give such useful information to serve as a guide for those who might care to use or investigate its possibilities.

Discovery

Hydrazine's history goes back to 1875 when the compound was first identified by the German chemist, Emil Fischer, in his investigation of various nitrogen derivitives. The Raschig process was introduced 32 years later. Although this synthesis involves inexpensive and abundant raw materials, the reaction, as initially developed, was slow and difficult to maintain.

The first major impetus to the large scale manufacture of hydrazine was the development of the German rocket program during World War II. Hydrazine was one of the rocket fuels selected, along with an oxidant such as hydrogen peroxide or liquid oxygen. For their rocket programs, the Germans in 1944 built two hydrazine plants, one at Leverkusen, the other at Gerstofen. Both of these plants, which reached full production in 1945, were designed to produce only the hydrated material.

Professor Audrieth and Dr. Mohr reviewed the chemistry of hydrazine in a Government report. Subsequently Prof. Audrieth and Dr. Ogg extended the bibliographic work in an excellent book, "The Chemistry of Hydrazine," which fills a real need for a comprehensive insight into the intriguing and highly useful field of hydrazine chemistry. Although neither is, in any sense of the word, a treatise on the subject, scientific and technical personnel in the various branches of chemical activity are now provided with basic reference sources readily available and reasonably complete.

Another excellent book on the chemistry of hydrazine is that written by Dr. Clark, published privately by the Olin Mathieson Corp.

Commercial Sources

The first commercial source of hydrazine and their compounds in the United States was started in 1939 by the Fairmount Chemical Company in Newark, N. J.

In 1948, the Mathieson Chemical Corp, began pilot plant production of anhydrous hydrazine, as well as salts, in Niagara Falls, New York. Actually, Mathieson's research on hydrazine applications dates back to 1939. The three major producers of hydrazine are: Fairmount Chemical Corp., Olin Mathieson Chemical Company and Metalectro Corp.

Of interest to mirror makers is hydrazine sulphate, $(NH_2)_2H_2SO_4$. This is a white or colorless powder or flake, readily soluble in water, is weakly basic, less than ammonia. It is primarily a monoacid base.

The price of hydrazine, responding to the effects of increased output, has declined markedly in recent years. Once selling for $50.00 a pound in research quantities, anhydrous hydrazine had a price tag of $9.00 a pound in 1948. Subsequently, the price dropped to $4.50 a pound, where it remained for several years. In February 1953, the price fell to about $3.00, and further price reductions since that time have been in the neighborhood of $2.00 per pound. The price today varies from 85¢ to 95¢ per pound.

Declining prices and increased availability will stimulate a more widespread use of hydrazine. Thus far, more than 2000 derivitives of this compound have been reported in the chemical literature. The applications are in medicine, fuels, boiler water treatment, as a flux employed in soldering metals, rubber accelerator, insecticides, etc.

The specific use of hydrazine or its compounds as a reducing agent for mirror making stems from the academic investigation of silver nitrate with hydrazine solutions and is accredited to Gmelin, Watt, Welsh, and Welsh and Broderson.

Formulary

Now that we have a better understanding of the chemistry of hydrazine and some of its early work, we will review the references to the literature in chronological order.

The first reference I have been able to locate in which hydrazine sulphate is used in silvering compounds specifically for mirror making is accredited to Marino, who in 1914 gives the following three-solution formulation:

Solution 1	
Potassium cyanide	140 parts
Water to saturation	
Solution 2	
Ammonium fluoride	60 parts
Silver chloride	100 parts
Solution 3	
Hydrazine sulphate	100 parts
Sodium hydroxide	60 parts
Water to saturation	

There are two definite objections to solutions 1 and 2. The former is decidedly poisonous, whereas the latter solution will tend to slightly etch the glass surface. Solution 3 is a saturated solution of hydrazine sulphate diluted with sodium hydroxide.

Mason, though he does not attempt to form mirrors on glass, does form silver films on electrolytically anodized aluminum surfaces. This is done by placing the aluminum in a 1% silver nitrate solution to which is added a small amount of potassium hydroxide and subsequently sufficient ammonia is added to redissolve the precipitate first formed.

The reducing solution consists of:

Hydrazine sulphate	0.5 gram
Water	200 c.c.

to which has been added 0.5 per cent sodium hydroxide solution. This latter solution is by far simpler to formulate than the previous one.

Freund and Deutsch mentioned the use of hydrazine as a reducing agent for silvering purposes in their patent, but gave no details for its use.

Peacock gives two formulations, to the first of which he adds hydrazine to the silver nitrate solution as follows:

Solution 1

Silver nitrate	1 ounce
Hydrazine sulphate	2 ounces
Water	100 ounces

Solution 2

Ammonia	1¾ ounces
Water	100 ounces

A modification of the foregoing solution may be made up of:

Solution 1

Hydrazine sulphate	2 ounces
Water	100 ounces

The silver solution proper may be made up of:

Solution 2

Silver nitrate	1 ounce
Ammonia	1¾ ounces
Water	100 ounces

Instead of ammonia, the following solution may be used, according to Peacock:

Sodium hydroxide	½ ounce
Water	100 ounces

Banks and Upton adds glycerine to their preferred silver nitrate solution, to which a trace of gelatin is likewise added to serve as a stabilizer. The solution was used by them in silvering wax electrotyping surfaces, although there is no reason why it will not work for glass and other surfaces. The recommended solution is made up of:

Silver nitrate	1.0%
Glycerine	15.0%
Gelatin	0.2%

The reducing solution by preference is made up of:

Hydrazine sulphate	1.5%

This latter is made slightly alkaline with ammonia. Once the silver film has been formed, it is electrolytically plated from an acid copper sulphate solution.

Milton, Cort, Nielson and Cowan with the United States Army, Medical Division, added a wetting agent (Triton N-100, made by Rohm & Haas Company) to the silver, as well as the reducing solutions, in the following fashion:

Solution 1

Silver nitrate	45 grams
Ammonia, sufficient to just redissolve the initial precipitate first formed	
Triton N-100	3 grams
Water to make up	1 gallon

The reducing solution is made up of:

Solution 2

Hydrazine sulphate	25 grams
Ammonia	15 grams
Triton N-100	3 grams
Water to make up	1 gallon

Morgan and Myers form a more concentrated silver solution consisting of:

Solution 1

Silver nitrate	114 grams
Ammonia (28.42%)	227 ml.

Add water to make 4.55 liters, filter and store in an amber bottle. The reducing solution is made up of:

Solution 2

Hydrazine sulphate	42.5 grams
Ammonia (28.42%)	45.5 ml.

Add water to make 4.55 liters, filter and store in an amber bottle. When ready to make mirrors, use equal volumes of solutions 1 and 2. Spray with an air pressure of about 40 pounds.

Hepburn adds glyoxal, another reducing solution, to the hydrazine sulphate in the following manner:

Solution 1

Hydrazine sulphate	2.7 ounces
Glyoxal	2 ounces
Water	100 ounces

The silver solution itself consists of:

Solution 2

Silver nitrate	3 ounces
Ammonia	2 ounces
Water	128 ounces

The solution was used for metallizing plastics by spraying techniques.

Cross found that a 50-50 mixture of 20 grams per liter of hydrazine sulphate with 12 c.c. per liter of formaldehyde, and 6 grams sodium hydroxide added to each solution was a very effective reducing solution. Stock solutions of higher concentrations should be made up and stored. When ready for use, it is diluted accordingly.

Gallo sells commercially the following two-solution formulation for electrotyping purposes:

Solution 1

Silver nitrate	3 ounces
Water	1 gallon

To this solution there is added sufficient ammonia to from a precipitate, thereafter adding sufficient ammonia to redissolve the precipitate first formed. The reducing solution consists of:

Solution 2

Hydrazine sulphate	¾ ounce
Water	1 gallon

Since these solutions are to be used in connection with electrotyping, Gallo refers to the use of ordinary faucet water without detrimental effects to the silver film. If the solutions are to be used for mirror making, distilled or deionized water must be used.

Trevail and Gladney make a more concentrated solution consisting of:

Solution 1	
Silver nitrate	4 ounces
Ammonia	8-12 ounces
Water	160 ounces
Solution 2	
Hydrazine sulphate	2 ounces
Magnesium sulphate	½ ounce
Water	160 ounces

Sodium, potassium, ammonium or magnesium sulphate may be used in solution 2 as the addition agent with the hydrazine sulphate, giving rise to a silver film with an improved reflecting surface devoid of cloudiness and as much as 1040 square feet coverage.

Upton and Herrington adds "Fixanol C" (a British type of wetting agent) to the silver solution and pyridine to the hydrazine sulphate solution.

Despite the high rate of deposition maintained on the sensitized surface, very little precipitate occurred in the bulk of the solution or on the walls of the containing vessel. The solution remained perfectly clear and still usable some 24 hours after preparation, during which time a number of objects had been silvered. It was believed at first that the effect of the pyridine addition was simply to reduce the silver ion concentration to a point where the reduction for any practical purpose would not proceed in the absence of a catalyst.

Despite the high rate of deposition maintained on the surface sensitized with tin chloride solutions, very little precipitate occurred in the bulk of the solution or on the walls of the containing vessel. The solution remained perfectly clear and still usable some 24 hours after preparation, during which time a number of glass objects have been silvered. The effect of stannous chloride treatment increasing the initial rate of mirror formation has been noted by previous investigators (Wein) and has been shown quantitatively. Upton and Herrington first described the effect of pyridine addition as simply to reduce the silver ion concentration to a point where the reduction for any practical purposes would not proceed in the absence of a catalyst.

However, experiments with other amines, which would give even lower silver ion concentration from dissociation of the general $AgBO_2H$, failed to reproduce the differential inhibiting effect of pyridine. It was therefore concluded that either an impurity was present in the redistilled laboratory reagent variety of pyridine used or the pyridine behaved uniquely in some way not understood. Tests were made with addition of other materials known to occur in pyridine, but while comparable results were obtained with alpha and beta picoline, results did not show that the phenomenon was traceable to any particular constituent.

When the process was recommended, however, as a practical means of heavily silvering plastics in the manufacture of a special electrical component, it was found that the results obtained were markedly dependent on the source and quality of the pyridine used, and that no differential inhibition of silver reduction occurred, when a sample of pyridine of purity greater than 99.0 mol. per cent was established by the freezing point, was used. Examination by the Chemical Research Laboratory in England of a sample of pyridine found to give satisfactory results revealed the presence of a very small amount of a surface active agent. When a sufficient amount of a surface active agent was added to pure pyridine, differential inhibition of silver reduction was obtained.

It was also established that the variable behavior of different pyridine samples were attributable to the varying proportions of surface active agent present. The desired results could be reproduced by adding a suitable proportion of "Fixanol C" (chemically, this is cetyl pyridinium bromide) to "inactivate pyridine" so that the process becomes completely controllable.

We shall now discuss the stages of inhibition. The addition of increasing proportions of surface active agent to a sample of pyridine giving no differential inhibition produces results in the following sequence: (1) no apparent inhibition of silver precipitation, (2) inhibition of precipitation in bulk of solution, but mirror deposition on walls of vessel, as well as a sensitized stannous chloride treated surface; (3) inhibition of precipitation in solution, no deposition on walls of vessel but good deposition on sensitized surface; (4) as (3), but poor deposition on sensitized surface; (5) complete inhibition, i.e., no deposition at all. These effects change with the age of the solution and, in general, any inhibited solution will start to deposit silver after some hours.

These observations suggest that pyridine itself has no unique property in this process. Good differential inhibitions have been obtained by adding bases instead of pyridine, notably ammonia and cyclohexylamine, in suitable concentration, together with the appropriate addition of cetyl pyridinium bromide ("Fixanol C") using solutions of the order of 0.001%.

The following is a recipe based on the use of pyridine. The surface to be silvered is pretreated by being wetted with a solution of:

Tin chloride	10 grams
Hydrochloric acid	20 ml.
Water	80 ml.

The surface is then rinsed with a 5% silver nitrate solution, well washed with distilled water and kept under water until required.

Two silvering solutions are prepared:

Solution 1	
Fixanol C (0.005%)	10 ml.
Hydrazine sulphate (1¼% solut.)	16 ml.
Solution 2	
1% Ammoniacal silver nitrate solution	70 c.c.

This silver nitrate solution is prepared by adding sufficient ammonia to a 1% silver nitrate solution until the precipitate just redissolves.

It is an established fact that only a small proportion of the reduced silver is deposited as a mirror on the required surface. The remainder is either deposited on the walls of the containing vessel or is precipitated in the solution and eventually forms a loose black sludge. Apart from the waste of silver involved, this sludge is objectionable, since it may spoil the mirror during its formation. After Upton and Herrington considered the foregoing factors, they improved the hydrazine solution by addition agents. Experiments on the agents will not be discussed.

While the mechanism of the silver process was under study, it was noted that a 1% ammoniacal solution of silver, to which about 10 to 15 per cent of pyridine had been added, did not show any appreciable deposition of silver on the addition of sufficient hydrazine sulphate to reduce all the silver present.

It was found that, on a surface which had previously been treated with a solution of stannous chloride and washed with water, a heavy silver mirror was rapidly deposited. The following tables show the rate of deposition of silver, and the considerable thickness of the mirrors obtained from the solution with the pyridine addition as compared with that obtained with the formaldehyde process.

70 ml.	1% ammoniacal $AgNO_3$
10 ml.	Pyridine
16 ml.	1¼ Hydrazine sulphate

Time in seconds	*Silver deposited gm. sq. dm.*	*Time In seconds*	*Silver deposited gm. sq. dm.*
30	0.0064	420	0.0424
60	0.0095	660	0.0598
180	0.0216	3600	0.164
300	0.0301		

Equal volumes 6% ammoniacal $AgNO_3$ and 1% formaldehyde

Time in seconds	*Silver deposited gm. sq. dm.*	*Time in seconds*	*Silver deposited gm. sq. dm.*
30	0.012	420	0.033
60	0.015	660	0.043
180	0.018		
300	0.028		

This silver nitrate solution is prepared by adding sufficient ammonia to a 1% silver nitrate solution until the precipitate just redissolves.

These two solutions are mixed just before use. The amount of Fixanol C solution is adjusted to give satisfactory results. No exact quantity can be recommended, since the amount required depends on the concentration of surface active agent already present in each batch of pyridine, and this may change with time.

The process has proved useful as a tool to investigate the catalytic effect of silver, platinum and various other metals from aqueous solution. Upton and Herrington are of the opinion that the method should be of considerable use wherever the rapid and efficient deposition of a heavy silver film is required.

This process has been used in England to apply a thick film of silver to the insides of the tubes, enabling this operation to be employed with a degree of precision in application where the spray method would not be practicable. It is considered that the process should be useful for instrument manufacture and for laboratory requirements. The investigators have succeeded in establishing that the influence of a detergent in inhibiting the deposition of silver is quite remarkable and this should enable the silvering to be undertaken with a greater degree of control.

Pyridine is, unfortunately, rather toxic, but now that the principal has been established, it should be possible to use the detergent addition established in silvering processes to improve the efficiency of deposition, using a rather higher ammonia concentration than usual instead of the pyridine addition.

Heritage and Balmer use a 10% tin chloride solution to sensitize the given surface. After washing, it is immersed in a 2% silver nitrate solution until a faint brown color is acquired. The surface is then washed with water and covered with the following mixture until the required silver thickness is obtained:

Solution 1	
Ammoniacal silver nitrate solution	70 ml.
Solution 2	
Pyridine	10 ml.
Hydrazine sulphate (1.25% solut.)	16 ml.

Solutions 1 and 2 are mixed immediately before using. The pyridine retards the reduction of the silver and more or less than the specified amount may be used.

It is interesting to record here the work of James who points out that the reduction of silver ions by hydrazine is very sensitive to the presence of small amounts of copper or copper sulphate. A silver nitrate, sodium sulphite solution which shows no sign of reduced silver undergoes almost immediate reaction after several minutes if merely stirred with a clean copper rod. Streamers of colloidal silver are observed passing out from the copper surface with gum Arabic added as a stabilizer. Similarly, small amounts of copper sulphate added to the solution caused rapid reaction. Likewise, in the reduction of silver chloride by hydrazine, the addition of 0.005 mole of copper sulphate to 60 ml. of the total solution volume reduces the induction period by four- or five-fold, and 0.05 mole of copper sulphate eliminates it completely.

Silverman and Neckerman tried phenyl hydrazine and report that (a) hot solutions rapidly turned black with silver nitrate solutions, giving rise to bubbles of gas. Pieces of tarry substances choked the test tube in which the test was conducted. No mirror was formed. However, a slight black coloration on the side of the test tube was seen. Cold solutions (b) also turned black giving rise to gas bubbles and forming no mirror. In both tests, the solutions were dilute.

Anonymous[2] refers to the use of hydrazine sulphate for forming silver films, but gives no details as to its use.

BIBLIOGRAPHY

1) Anonymous
Chem. & Eng. News, Vol. 31, p. 880, 2980, 1953
Chem. Week, Vol. 73, p. 42, 1953
2) Anonymous
Metalloberfl. Vol. 35B, p. B-3, 1951
Audrieth, L. F.
Jour. Phys. Chem. Vol. 34, p. 538, 1930
Chem. Rev. Vol. 15, p. 169, 1934
Audrieth, L. F. & Mohr, P. H.
Jour. Chem. Eng. Vol. 26, p. 3746, 1948
Chem. Ind. Vol. 58, p. 424, 1946
Audrieth, L. F. & Ogg, B. A.
"Chemistry of Hydrazine," 1951
Banks, W. H. & Upton, P. B.
Brit. Pat. #596,732 Aug. 1, 1945
Clark, C. C.
"Hydrazine," privately published by the Olin-Mathieson Chem. Corp; Baltimore, Md.
Cross, I.
Private communication
Fairmount Chemical Corp.
600 Ferry St., Newark 5, N. J.
Fischer, E.
See Fischer and Hunsalz
Fischer, E. & Hunsalz, P.
Ber. Vol. 27, p. 178, 1894
Freund, E. & Deutsch, F.
U. S. Pat. #2,186,452 Jan. 9, 1940

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Summaries of Glass Conference Papers

Forced Air Circulation In Electric Lehrs, By Georges Adeline
Equipment For Electric Melting Of Glass, By Edward A. E. Rich
Theory Of The Rate Of Stress Release In Tempered Glass, By C. J. Phillips

Forced Air Circulation in Electric Lehrs

By Georges Adeline
Cobelcomex, Brussels, Belgium

The annealing of glass problems consists of three phases: (1) bringing the glass to a determined temperature which will allow the release of the strains introduced between production and loading into the lehr; (2) maintaining the required temperature during the times necessary for complete release of the strains; (3) uniform cooling of the glassware, avoiding the formation of new strains.

The heating means used are varied and include coal gas, natural gas, fuel oil, electricity. The means of transferring the calories effectively brought into the oven are (1) radiation, (2) natural convection and (3) forced convection.

The thickness of the glass and its shape influence absorption of radiant heat. Color also plays a part. Natural convection is more theoretical than real and can hardly be considered from a practical point of view. Forced convection permits one to move the air inside the lehr at desired, well determined and controlled velocities. Ventilation may include the addition of outside air and involve only a determined part of the lehr; consequently, the convection can be made in open or closed circuit.

In the closed circuit convection, as the air is comprised in a determined section of the lehr and is constantly in movement without addition of outside air and without exit of hot air, there is a considerable economy in calories and the result is a uniform inner temperature in the considered portion of the lehr and the possibility of very accurately controlling this temperature. Consequently, the convection in closed circuit is of special interest at the high point of the annealing curve.

Convection and ventilation in open circuit allow that, on the contrary, by addition of cold air, quickened cooling can be produced in the lehr at the time when the glass can stand a sudden drop of temperature without the danger of creating new stresses. In addition, forced convection, avoiding the formation of irregular hot zones in the lehr, creates a uniformity of temperature throughout a determined portion of the lehr by its movement as well as by its velocity.

The study of forced convection and its effects has led to new ideas in the design of the annealing equipment as well as in that of the heating zone. The characteristics of this new equipment are as follows: (1) dividing the lehr into unit sections; (2) accurate temperature control in each section and throughout the tunnel; (3) accelerated chilling from a determined temperature; (4) automatic heat control and reduction to a minimum of the temperature deviations from the pre-established curve; (5) possibility of modifying the curve.

The integral use of convection has led Cobelcomex to use electricity almost exclusively. In fact, in a lehr having the old characteristics, the use of electricity is not rational because it entails the use of heating means proceeding from a physical phenomenon in ovens designed for heating by means of combustion, which is a chemical phenomenon. Such lehrs, due to this, demand an important evacuation of the combustion gases and, consequently, of the calories produced. If the use of electricity is applied in a lehr specially designed for its proper characteristics, its use can be made under excellent conditions of economy.

As far as convection is concerned, no other means of heating allows a more rational application. The forced air can pass directly on the heating coils and use the produced calories to the maximum, which is practically impossible with all other heating means in which intermediary transfer means have to be used. The electric current can be switched on or off as often as desired with the speed and the required accuracy and, consequently, it is possible to regulate the heating and the consumption with precision.

In brief, the T. M. lehr consists of relatively short units (5′0″) which, when assembled, form the tunnel (widths: from 1′4″ to 10′; heights: from 1′2″ to 2′8″). The total length of the oven and its width vary according to the length of the heat treatment and the area occupied by the treated tonnage. It is entirely metallic, using heat resisting steel in the heating parts. Either lateral, horizontal air circulation or vertical air circulation is used, according to the objects to be annealed.

In the system with vertical convection, each unit is equipped with fans placed in the top of the lehr and below the belt. The fans in the top draw the air upwards through the belt, through the ware being annealed and through the heating element which is fixed in the top of the tunnel. The riding air is forced back, by the same fan, to the top of the second half of the unit which is likewise equipped with a heating element. The air completing its circuit crosses from top to bottom, the heating element, the glassware and the lehr belt. The second ventilation fan placed under the belt in the second half of the unit again takes the air traveling from top to bottom and drives it back under the belt of the first half of the unit where this air continues its rise through the glassware. The air circulates, therefore, in a closed circuit, propelled by the two fans. Its temperature is maintained constant by the action of two heating elements placed in the circuit. The circuit is reversed in the following unit. The heating elements are always located in the top of the tunnel. The quickened cooling is obtained by a powerful blower distributing fresh air by means of a special device easy to regulate. Performance records for these lehrs are given in Table I.

TABLE I
PERFORMANCE DATA ON COBELCOMEX T. M. LEHRS

Type of Ware	Lehr Length	Width	Production	Times	Consumption
Tableware	50'6"	3'3"	6 tons/8 hr.	30 to 40'	30 Kwh/h (25 to 30 W.
Bottles	39'6"	3'3"	20 tons/24 hrs.	40 to 50'	10 Kwh/h per kg.)
Glass containers	50'6"	3'3"	20 tons/24 hrs.	30 to 50'	20-30 Kwh/h
Glass blocks	79'	3'7"	720	1 hr. 10'	30 Kwh/h
Cathode ray tubes	72'6"	6'7"	screens 17" cones	75'	40 Kwh/h 80 Kwh/h
Complete	17"			90'	lower than
Complete	21"	4'8"		120'	100 Kwh/h
Bulbs 60W loaded cold	27'10"	1'11¾"	75,000/24 hrs.	20'	36 Kwh/h
Decorating	72'2"	6'7"	35 tons/24 hrs.	2 hr.	80 Wh/Kg. glass

The life of the T. M. lehrs is exceptionally long as the use of refractory bricks is entirely eliminated. The electric heating is obtained with elements operating at a relatively low rate and, therefore, without fatigue. The conveyor belts are kept perfectly flat by means of a system of circulation on skid bars instead of rollers, and the belt on its way back into the lehr ascends, so to speak, the temperature curve and reaches the entrance of the lehr at exactly the right temperature. Consequently, the belt is not subject to any thermal shock which might result in deformations along its travel. Likewise, the heating being obtained by convection and not by radiation, there is no overheating at any place. The maintenance of the lehr is quite low for replacement of elements requires only a few minutes instead of a major shutdown, replacement of fans requires only 0 minutes, no foundation is needed and the lehrs may be easily moved.

A U-shaped decorating lehr has been built by Cobelcomex. In this lehr, the air system for the heating units and the cooling units are cross-connected so that the heat from the cooling ware is utilized for heating the incoming ware. This, of course, requires that a symmetrical heat curve for the operation be established.

The principle of forced convection has also been adapted to the treatment of flat glass, especially for optical glass.

Equipment for Electric Melting of Glass

By Edward A. E. Rich
General Electric Company, Schenectady, New York

Electric glass melting places the bulk of the electric energy received at the glass melting electrodes directly into the body of the glass itself. It is almost always used in conjunction with other fuels for melting, such as gas and oil.

If the bulk of the energy needed for actual melting is supplied from electric sources, the process tends to be called direct electric melting, even though a flame blanket may be used over the glass to supply tank losses, etc. If electric energy is used principally as a supplement to the actual glass melting energy derived from more usual fuels, the process tends to be called booster electric melting. Precise distinction between direct and booster melting is not made industry-wide at the present time.

Over-all economics are as follows. (1) More tons per day of glass can be melted. The incremental investment in electric melting equipment, as compared to the investment required for a new tank of conventional design to obtain the increased capacity, may be relatively small, or considerable, depending on the particular changes needed. (2) Better quality of glass can be produced, without necessarily sacrificing production. (3) Longer effective life of certain refractory linings can result for same total tonnage output of melted glass. This is less true for those refractories exposed to higher operating temperatures during electric melting. (4) Better flexibility of pull often occurs by using booster melting.

Ordinary soda-lime glass, with normal proportion of cullet, is said to consume 400-600 Kw hours per ton when melted by booster melting. Tank design, efficiency of utilization of the electric energy supplied, the kind of glass being melted and whether booster or direct melting is planned, affect actual kilowatt-hours of electric energy needed per ton of glass melted. Relative single phase voltages needed for booster melting may be summed up roughly as follows:

Lime glass	90 volts
Lead glass	250 volts
Borosilicate	325 volts

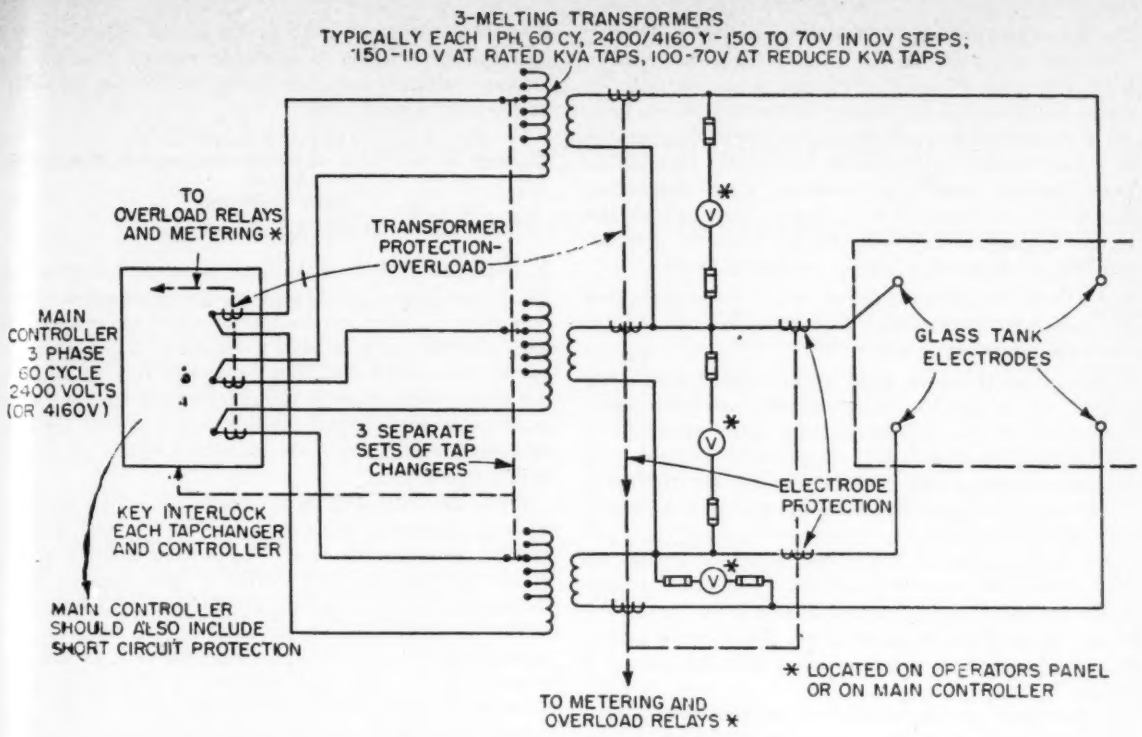
These figures show relative voltages needed for the same tank and electrode configurations, but may not necessarily be correct for any particular installation. Variation in electrical resistance of glass with temperature is great and is a reason why flexibility in voltage available at the electrodes is needed. As an example for lime glass booster electric melting, some glass manufacturers feel a voltage range of between say 150-70 volts is preferred. Least equipment price results by using reduced kva taps between these voltages because the physical size of the transformer is least. Fig. 1 shows a representative melting arrangement using rated kva taps between 150 and 110 volts and reduced kva taps between 100 and 70 volts.

It is known that glass has negative resistance versus temperature characteristics: that is, as glass becomes hotter, its resistance to the flow of electric current becomes less. For example, suppose that constant voltage is applied to a given glass batch. As the current flows through the glass, increased temperature of the glass results, which in turn means increasingly lowered resistance of the glass, which in turn means that since the voltage applied is constant, more current will flow. This causes the temperature to increase still further, and so on, until, in time, a runaway condition may be reached.

A saturable core reactor in series with the load current supplying the electric energy to the glass has an impedance characteristic which is opposite to that of the glass and, if properly selected, helps to give stable operating performance.

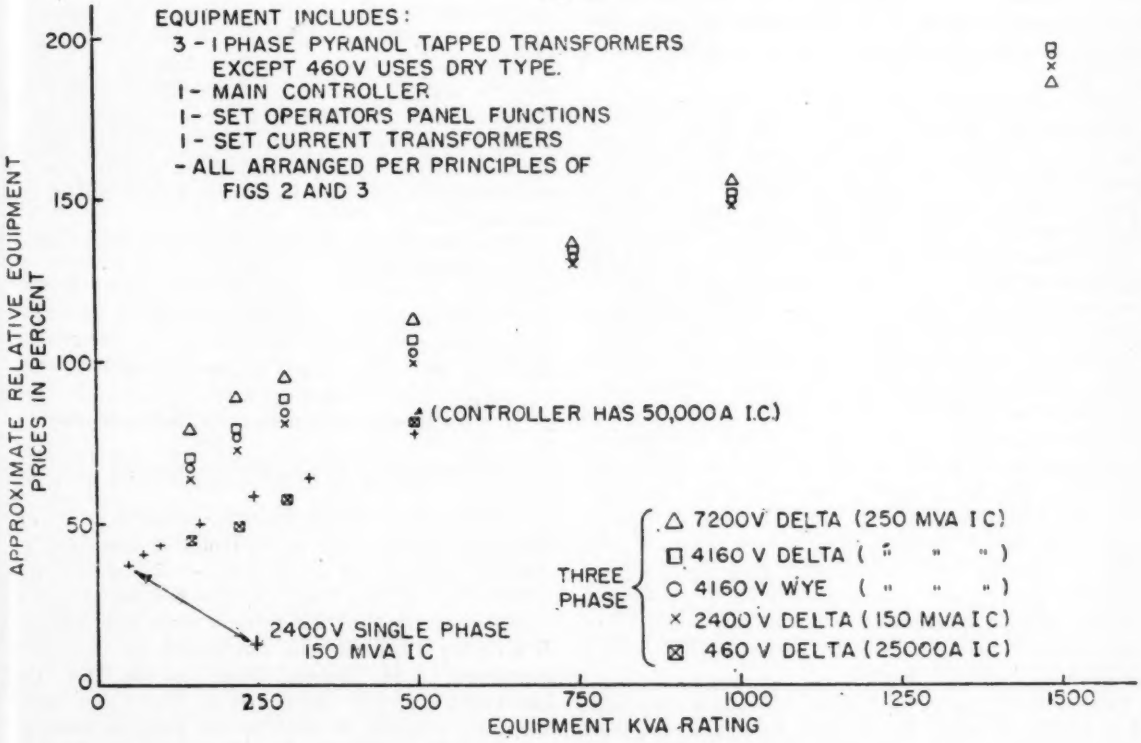
Another method of obtaining satisfactory operation in controlling current flow has been found to use an induction voltage regulator equipped with automatic current regulating features. In usual practice, constant current is held in the load circuit supplying the glass. Pronounced temperature changes in the glass take appreciable time to occur. Induction regulators equipped with automatic constant current regulating features can ordinarily easily keep ahead of the inherent tendency of the current to increase as the glass resistance decreases.

Constant current operation inherently tends to hold constant temperature in the glass. Energy loss in the glass varies directly as the product of the current squared and the glass resistance. If the glass starts to cool, its resistance increases. The constant current regulator will in turn increase applied voltage until the desired current level is again reached. This forces more energy into the glass thus



3 PHASE GLASS BOOSTER MELTING USING ONLY TAPPED
MELTING TRANSFORMERS

Fig. 1.



RELATIVE EQUIPMENT PRICES FOR ELECTRIC
MELTING OF GLASS

Fig. 2.

tending to increase temperature of the glass.

On the other hand, should the glass temperature be too high, the result of constant current operation is to decrease the applied electric energy to the tank, due to lower glass resistance, thus tending to restore the temperature to a lower value. As a practical matter, the time lag between energy input and resulting glass temperature changes by this method is ordinarily long enough that simple manual control may be adequate to maintain stability of current flow within reasonable limits.

All these comments are based on maintaining constant BTU input to the glass tank from other fuels in order to make the reasoning clearer.

Some users of booster melting feel simple tapped transformers are adequate to obtain sufficient voltage range of control of electric booster melting, even allowing for variation of resistance with temperature. If used with adequate metering and protection to the electric equipment and to the personnel involved, such claims appear well founded.

Electrode protection is provided to guard against excessive electrode current overloads. Transformer protection is needed to avoid possible damage from overheating of any winding of any transformer. Short circuit protection of all equipment is best included with the main controller.

Metering of volts and amperes to all electrodes is very helpful to operators. Voltage levels are usually selected by extending primary windings and supplying taps on primary and/or secondary windings of melting transformers.

Actual control of the entire electric melting energy involved is almost always best done by handling the entire load of saturable reactors (or other regulators), plus melting transformers, as though it were a motor starting problem.

The following have been done in order to improve safety and to minimize certain adverse effects: (a) The steel pattern of the supporting structure for the tank is sometimes broken up so as to minimize closed loops of large expanse which might tend to by-pass currents through them. (b) Catwalks, and related structures, may be insulated. (c) Grounding of the tank crown or other parts of the tank proper may be avoided on the premise that this tends to failure of the tank should grounds in the electric booster melting equipment or cables, etc., occur. (d) Equipment should be used that has the same kva output possible throughout quite a voltage range in order to assure the capabilities of getting electric energy into the glass regardless of the voltage needed. If necessary, equipment should be selected which has extreme flexibility of voltage in mind in order to handle lime and lead, and sometimes borosilicate glasses. The wide range of voltages needed for electric booster melting of these glasses is often best obtained by the usual extended tapped transformer primary winding, plus a series parallel switch on the secondary of each transformer to extend the constant kva rating over a larger voltage range, plus a saturable reactor for vernier control of current.

Fig. 2 shows present day relative three-phase glass melting equipment costs for various voltage levels. Also shown are comparative single phase glass melting equipment costs for 2400 volt power supply. To add saturable reactors (one per phase) and to include necessary excitation and protective features requires basic costs of Table 2 be increased about 35-75%. The use of induction voltage regulators in lieu of saturable reactors generally increases equipment costs from about 0-25% over the saturable reactor scheme costs.

Theory of the Rate of Stress Release in Tempered Glass

By C. J. Phillips
R.C.A., Camden, N. J.

In 1948, Lloyd Black of the Glass Research Laboratories, Pittsburgh Plate Glass Company, directed a series of experiments to determine the rate at which tempered glass loses its strain when exposed to elevated temperatures for various periods of time. Black's results were so interesting and of such practical significance that attempts were made to develop equations which would predict the loss of stress at higher and lower temperatures and for longer and shorter times.

Black used 12″ x 12″ x ¼″ plates of Ford City tank glass as specimens. These were tempered in such a manner that the strain was as even as possible throughout the area of the plate and had a value of approximately 3200 Mu per inch, which we commonly designate as full temper.

The tempered plates were subjected to temperatures between 425°F. and 970°F. for intervals of 3, 23 and 119 hours. After the plate had remained at a given temperature for a predetermined time, it was removed from the furnace and, when cool, the strain was measured through the four corners. The plate was again inserted in the furnace and allowed to remain for the next time interval and the process repeated. Each sample, therefore, was heated and cooled three times. Different results would undoubtedly be obtained if one sample were heated 3 hours, another 23 hours and the last 119 hours, without intermediate observations. Another difficulty is that the decay is so rapid at the higher temperatures, much of the double refraction has disappeared before the glass can be heated to that point. Nevertheless, the procedure was entirely straightforward, and perhaps of greater practical value than it would have had under more idealized conditions.

The empirical formula shown duplicates Black's observations quite faithfully:

$$\text{Log } F = \text{Log } F_\theta - \frac{K}{A} \log (Bt + 1)$$

Here F = stress (Kg./mm²) at time t (hours)

F_θ = initial tempering stress, 5.0 kg/mm² central tension, so Log $F_\theta = 0.7$ approximately

$\frac{K}{A}$ = quantity varying with temperature

B = quantity varying with temperature

This equation has values at two typical temperatures:

At 895°F. (480°C.) $\text{Log } F = 0.7 - .58 \log (13t + 1)$

At 616°F. (324°C.) $\text{Log } F = 0.7 - 0.43 \log (1.5t + 1)$

A physical basis for this formula came from the work of Littleton and Lillie who emphasized the tremendous importance of the "thermal history" of the glass. They found that a rapidly cooled rod or fiber could have a temporary viscosity as much as one hundred times less than for a slowly cooled rod or fiber of the same kind and size. In effect, this means that the conditions of a higher temperature state can be "frozen" in glass to a degree de-

(*Continued on page* 444)

Czechoslovakian Papers of Interest to the Glass Industry: Translations

COPPERING OF GLASS ORNAMENTS

In a paper under the above title by Vladimír Biciste in *Ceskoslovensky Sklár a Keramik*, Vol. **3**, No. 4, p. 72 (1953), the author describes a method developed by Ing. Sácha for the coppering of glass ornaments.

The procedure consists of the following operations: (a) activation of the glass surface by $SnCl_2$, (b) forming of a thin silver coating, (c) coppering and (d) washing operation.

A freshly prepared solution of $SnCl_2$ should be used, since the stannous chloride loses its effectiveness on standing. The thin silver coating can be formed by treating the activated surface with a 0.05% $AgNO_3$ solution in aqueous ammonia.

This solution is poured into the cup (the object to be decorated) and immediately a few drops of aqueous formaldehyde are added in order to reduce the solution. As soon as the walls begin to get yellow, the silvering operation is finished and the solution should be poured out.

The formation of a fine and uniform silver coating is essential in order to get a well-adhering copper coating. For coppering, a freshly prepared Fehling solution is used.

The cups are filled with the Fehling solution of 40° C., and a few drops of aqueous formaldehyde are added. When the coating gets opaque, the process is considered finished and the solution should be poured out. The cups have to be rinsed with distilled water and then should be inverted in order to drain out the remaining water through the opening. The solution can be used until it is exhausted; that is, as long as it has the blue color.

The finished Christmas ornaments have a nice lustre and are of a red color. By using this procedure, 99% of the silver is saved, since a hundred times weaker $AgNO_3$ solution is used.

GLASS FOR ABSORPTION OF X-RAYS

A paper under the above title was published by Ludvik Kdousek in *Ceskoslovensky Sklár a Keramik*, Vol. **3**, No. 2, p. 27 (1953). Glass used for the absorption of X-rays should contain one or more of the heavy metal oxides, such as BaO, PbO, ThO_2, WO_3 or Bi_2O_3. It should absorb X-rays in large measure. This effectiveness is measured by comparing the glass with a sheet of lead that would absorb the same amount of X-rays. Therefore, its protective strength can be expressed in terms of its lead equivalent. The effect of protection can also be expressed as a coefficient of protection, defined as the ratio (multipled by 100) of the thickness of a sheet of lead to the thickness of a sheet of glass that absorb X-ray to the same extent:

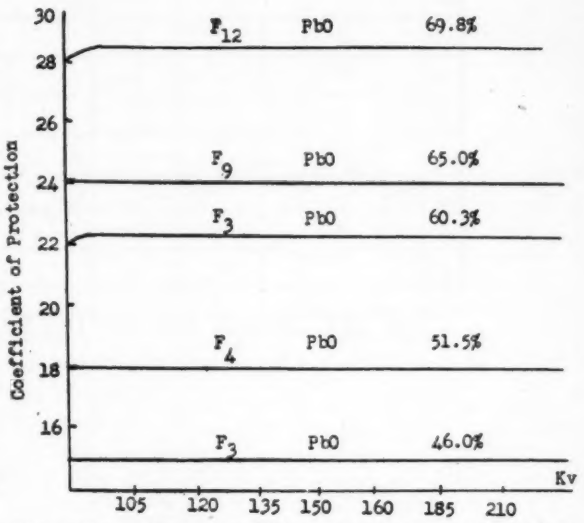


Fig. 1. Dependence of coefficient of protection of lead glass on voltage.

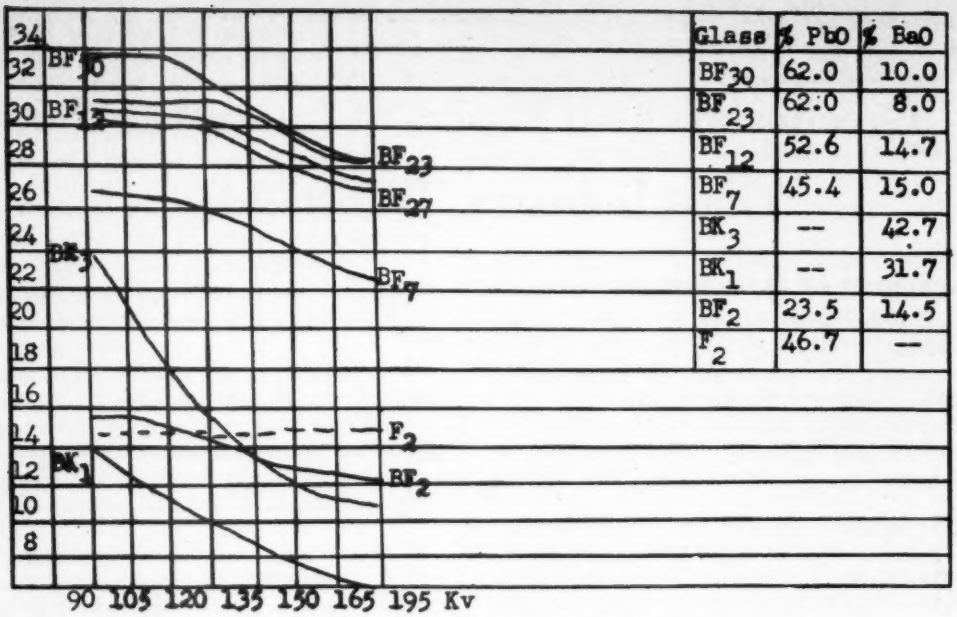
$$\alpha = 100 \frac{\text{d Pb}}{\text{d Glass}}$$

The Czechoslovakian standard for health protection requires a sheet of glass of 8 mm. thickness to give the same protection as a sheet of lead 2.5 mm. thick, i.e. α to be 31%. The lead equivalent of glass which absorbs X-rays is different at different voltages. The penetration increases with increasing voltage. There is a noticeable decrease in the lead equivalent of lead-barium glass when voltage increases from 90 to 195 Kv. The lead equivalent of glass containing lead, on the other hand, does not change with voltage. This fact is illustrated in Figures 1 and 2. Figure 1 also shows that glasses containing lead up to 75% do not reach the prescribed coefficient of protection. Some glasses containing both lead and barium give larger coefficients of protection, especially glasses containing PbO 45 to 62% and BaO 8 to 16%. BaO is introduced in the form of $Ba(NO_3)_2$ or $BaCO_3$.

In the series of PbO-BaO glasses, the coefficient of protection increases nearly linearly with specific gravity and the index of refraction.

Based on this relationship, a method for the control of melting of this glass can be worked out, thus insuring that the coefficient of protection would not change from batch to batch. The preparation of the melting pots is important. In Russia, one-pot furnaces are used which can be controlled easily. The front wall of this furnace is built so that it can be lifted up by a pulley and chains. The pot with the molten glass in it can also be lifted. This furnace has an opening in front through which the mixing can be done with a mechanical mixer.*

* The atmosphere in the furnace should be non-reducing, since otherwise the lead oxide would be reduced and would settle down to the bottom of the pot.



Glass	% PbO	% BaO
BF_{30}	62.0	10.0
BF_{23}	62.0	8.0
BF_{12}	52.6	14.7
BF_{7}	45.4	15.0
BK_{3}	--	42.7
BK_{1}	--	31.7
BF_{2}	23.5	14.5
F_{2}	46.7	--

Fig. 2. Change of coefficient of protection of lead-barium glass with rising voltage.

After the different operations in the production of this glass have been completed, the glass has to be tested thoroughly. The glass should not contain any bubbles, stones or other impurities. It should have the coefficient of protection that satisfies the standard requirements. Normally, sheets of 12 mm. thickness are made.

If the glass is yellowish, there is an indication that some iron, manganese, nickel or copper have been introduced along with the raw materials. The sand used for this glass, therefore, should not contain more than 0.013% Fe_2O_3.

After a series of experiments, a glass was compounded that gives a 35% coefficient of protection. In it, thorium oxide rather than lead oxide was used. The composition of this glass is:

SiO_2—28.7%
B_2O_3— 6.6
Na_2O— 3.0
BaO—44.0
ThO_2—17.7

SEALING GLASS

Milos Volf (*Ceskoslovenský Sklár a Keramik*, Vol. 3, No. 1, p. 5 (1953)), has submitted that an alloy composed of iron, nickel and cobalt was found to be most suitable for sealing into glass. It has many advantages over the other two metals, tungsten and molybdenum, that were used for this purpose for a long time. It is cheaper, and can be shaped easier, too. By changing the proportion of its component metals, its coefficient of expansion can be altered and brought to agree with that of tungsten, molybdenum and even with that of platinum.

It differs from them substantially in that the shape of its dilatation curve is much closer to that of glass. Both tungsten and molybdenum have a constant coefficient of expansion, but the glass used with them has a different behavior. It shows a sudden kink on its dilatation curve at the transformation temperature. At that point, the dilatation curve suddenly rises. In consequence of this difference between the dilatation curves of the metal and the glass, a tension is originated in the glass. On the other hand, the curve of the alloy of iron, nickel and cobalt shows a very analogous course to that of the glass used with it for sealing.

The glass well suited for the sealing with this alloy is one composed of silicon oxide, boric oxide and alkali oxides. It contains a very small amount of aluminum oxide. The temperature of transformation of this glass coincides very well with that of the alloy.

This type of glass contains boric oxide in an amount as high as 24%, which gives the glass a low temperature of transformation (around 450°C.) and a stronger adhesion to the metal. By dissolving the metal oxides on the surface, boric oxide improves the seal substantially.

Other characteristics that have to be taken into consideration when sealing metals in glass vacuum tubes are the electric conductivity and the power loss. The power loss of the sealing glasses should be very low, the tangens of the loss angle should be below 30×10^{-4}. The alloy and the glass used with it satisfy these requirements.

Glasses known to have low power losses are Osram glass W_2 and Corning glass C 707. Those are glasses containing a high percentage of boric oxide and mainly lead oxide. The content of alkalies is low.

The production of sealing glass is a delicate procedure and great care is required. The sealing glass has to be homogeneous, of high purity and a high mechanical strength. The sealing glass is melted in small pot furnaces. These small pots have to be exchanged quite frequently since the boric glass causes corrosion.

● An 8-inch cube of glass weighing over 110 pounds, yet occupying less space than a shoe box, is being exhibited in Geneva, Switzerland, at the United Nations Conference this month. The glass sample is one of two 8-inch cubes of radiation-shielding glass being supplied by Corning Glass Works for an "Atoms for Peace" exhibit.

Inventions and Inventors

Annealing and Tempering

Apparatus for Bending Linear Glass Tubing. Patent No. 2,698,501. Filed December 13, 1950. Issued January 4, 1955. Five sheets of drawings (none reproduced). Assigned to Sylvania Electric Products, Inc. by Sandford C. Peek, Jr. and Orrick H. Biggs.

In the manufacture of circular fluorescent lamps from linear glass tubes, a proper heating of the tubes to permit satisfactory deformation to a circular configuration is a most important consideration. A linear glass tube is held by a holder and seated on a support and moved through a plurality of stations at which heating of a tube is effected. This heating operation is continued until the tube elongates a predetermined amount calculated to insure the desired plasticity for the rolling operation. The tube is then moved to the rolling station where the lower end is grasped by the rolling mechanism and the rolling operation is effected, the tube support swinging clear of the rolling mechanism as the roller moves upwardly. Upon completion of the rolling operation, the roller is disengaged from the tube and the tube is then carried through the remaining stations to the unloading station. Since the tube is seated on a support, as well as held by a holder, it can be heated sufficiently at the heating stations to permit it to be moved from the last heating station to the rolling station without the necessity for additional heating at the rolling station.

The patent contains nine claims and the following references were cited: 1,493,044, Leiman, May 6, 1924; 2,146,572, Hahn et al., Feb. 7, 1939; 2,270,152, Themak, Jan. 13, 1942; 2,494,872, Greiner et al., Jan. 17, 1950; 2,494,923, Yoder et al., Jan. 17, 1950; and 2,611,216, Snow et al., Sept. 23, 1952.

Glass Compositions

Polyphase Systems of Glassy Materials. Patent No. 2,693,668. Filed April 3, 1951. Issued November 9, 1954. No drawing. Assigned to Owens-Corning Fiberglas Corporation by Games Slayter.

This invention relates to the manufacture of a new composition for matter and it relates more particularly to the composition of matter based upon a heterogeneous, highly-stressed system consisting of a dispersed phase, preferably in fibrous form, randomly arranged or oriented within another phase or phases, which may exist in fibrous form or as a matrix. The following compositions may be used:

GLASS COMPOSITION A

	Per cent
Silica (SiO_2)	50-60
Aluminum oxide (Al_2O_3)	12-16
Boron oxide (B_2O_3)	9-11
Calcium oxide (CaO)	16-19
Magnesium oxide (MgO)	3-6

Glass formed of the above composition may be worked in a temperature range of about 2000-2800° F. and has a coefficient of thermal expansion of about 55 $\times$ 10^{-7}.

GLASS COMPOSITION B

	Per Cent Per cent
Silica (SiO_2)	40
Aluminum oxide (Al_2O_3)	33
Boron oxide (B_2O_3)	10
Calcium oxide (CaO)	13.5
Magnesium oxide (MgO)	3.5

Glass formed of the above composition may be worked at a temperature within the range of 2100-2900° F. and has a coefficient of thermal expansion of about 33 $\times$ 10^{-7}.

Each of the compositions, A and B, may be separately processed as by melting to temperatures within the range prescribed to form their respective glasses. Such glasses which are separately prepared are then reduced to finely divided form, such as to a particle size of about 0.004 inch. The particles of A glass and B glass are then mixed together in amounts to provide a minimum of 10 per cent of A glass in B glass or 10 per cent B glass in A glass, but such glasses are preferably combined in the ratio of about 40-60 per cent by weight A glass and 60-40 per cent by weight B glass.

The mix of A glass and B glass is heated to a temperature of about 2550-2650° F. for a time sufficient to reduce all of the particles to flowable state, but insufficient to enable diffusion of one glass into the other to any great extent. While in flowable condition, the mass is rolled or otherwise formed into thin sheets as a result of which substantially all of the glass particles are drawn out into fibers apparently bonded together by slight fusion between phases to form a solid body. Instead of rolling or working the flowable composition into sheet form, the heterogeneous glass composition may be drawn or otherwise attenuated into fibers, a cross-section of which will be formed of highly stretched fibers of each of the glass compositions in substantially orientated but separate phases and with apparently sufficient fusion between the fibrous phases at their surfaces to integrate the fibers one to another in the formation of a composite mass.

When reduced to room temperature, the fibers formed of A glass having the higher coefficient of thermal expansion will be under tension while the fibers formed of B glass will be under compression such that a volume stressed condition will exist in the final product to impart greater strength and higher resistance to thermal or mechanical shock.

The patent contains 10 claims and 12 references were cited.

Composition of Glass Having High Ultraviolet and Low Visual Transmission. Patent No. 2,693,422. Filed August 25, 1951. Issued November 2, 1954. One sheet of drawings (none reproduced). Assigned to Pittsburgh Plate Glass Company by J. E. Duncan and John J. Smith.

This invention pertains to glass composition, and more particularly to an improved glass composition characterized by high transmission in the ultraviolet region and

substantial opacity in the visible portion of the spectrum. In general, the objects of the invention are accomplished by the addition to a conventional glass composition formula (chosen so as to be free from components excessively absorbtive of ultraviolet light) of a mixture of metallic oxides for absorbing the unwanted visible portion of the solar spectrum. These added metallic oxides are the oxides of copper, nickel and cobalt, the amounts and permissible ranges of which are specified in detail below in Table I. We have found it to be quite important to avoid the inclusion of iron oxide in the coloring material because, while iron oxide is often employed to aid in the absorption of the longer (red) wavelengths of the visual spectrum, it has the disadvantage that unless maintained in the condition of ferrous ions, this material will also absorb undue amounts of the near untraviolet. Manganese is also preferably avoided in view of the difficulty of controlling its effect. An example of a suitable formulation is as follows:

	Per cent
SiO_2	68.68
Na_2O	13.40
CaO	11.35
MgO	2.20
Al_2O_3	0.12
Fe_2O_3	0.04
As_2O_5	0.68
CuO	2.00
NiO	1.28
CoO	0.25

Table I

	No. 1	No. 2	No. 3	No. 4	No. 5	Range, per cent
Cu0	2.5	2.0	3.0	1.5	2.0	1.5-3.0
Ni0	0.80	2.0	0.75	0.75	1.28	0.75-2.0
Co0	0.28	0.14	0.25	0.35	0.25	0.1-0.4

The patent contains 2 claims and the following references were cited: 1,122,065 Brady Dec. 22, 1914; 205,381 Great Britain 1923; and 430,387 Great Britain 1935.

Method of Preparing Felted Products Containing Glass Fibers. Patent No. 2,698,558. Filed January 17, 1952. Issued January 4, 1955. No drawings. Assigned to Hawley Products Company by Don M. Hawley and John C. Williams.

A process is described for producing felted products from glass fibers by means of a wet process. The wet process offers an advantage over the conventional dry process in that airborne fine particles are not present and a more uniform density is possible. An example of one successful process is as follows: The following ingredients are dispersed in 2 gallons of water at 120°F. in the order given

10 grams caroa fiber
20 grams polyester resin (Laminac flexible polyester PDL 7-633 catalyzed with 1% benzoyl peroxide)
40 grams ½-inch cut glass fiber roving

A heavy agglomeration of the glass fibers is obtained. The mixture is agitated and the water temperature is brought to 180°F. and the agitation continued until the fiber is no longer sticky, indicating that the resin has been cured. A preform felted from this bath contains a very heavy agglomeration of glass fibers and is suitable for impregnation with a thermosetting resin such as a polyester resin followed by molding.

The patent contains 12 claims and 11 references were cited.

Ophthalmic Glass. Patent No. 2,699,398. Filed February 18, 1952. Issued January 11, 1955. No drawings. Assigned to Corning Glass Works by William T. Armistead.

This invention relates to glasses having refractive indices (n_D) in the neighborhood of 1.63 to 1.66 and dispersive indices (V) of about 40, together with sufficiently low softening points and sufficiently high chemical durability and resistance, to devitrification for utilization as the high-index segments in multifocal ophthalmic lenses. The following compositions calculated in per cent by weight from their respective batches illustrates some of the possible improved glasses:

	1	2	3	4	5	6	7	8
SiO_2	37	36.5	39.2	40	38.1	38.5	37	33.8
PbO	22.7	24	30	25	20	30.2	22	24.7
BaO	22	22	15	15	20	15	22	22
ZrO_2	7	7.3	5.2	5	7	5.2	7	7
K_2O	...	2	...	...	...	...	6	7
Na_2O	6.8	4.7	6.1	9	7.9	7.1	2	...
Li_2O	...	...	0.5	...	...	...	...	1.5
B_2O_3	3.5	3.5	4	5	5	4	4	4
TiO_2	1	...	...	1	2	...	...	...
n_D	1.660	1.659	1.653	1.637	1.652	1.652	1.647	1.660
V	40.4	40.7	39.7	40.9	40.9	39.3	42	40.5
Softening Point, °C	665	676	620	635	665	635	689	666

The patent contains five claims and the following references were cited: 2,523,266, Armistead, Sept. 26, 1950; 2,606,841, Armistead, Aug. 12, 1952; and "Rx Lenses," American Optical Company Catalog, page 64, published in 1950.

Method of Producing Fibers from Glass and Other Heat-Softenable Materials. Fig. 1. Patent No. 2,699,631. Filed July 12, 1951. Issued January 18, 1955. Four sheets of drawings. Assigned to Owens-Corning Fiberglas Corporation by Charles J. Stalego.

This invention relates to a method for producing fibers from heat softenable materials, such as glass, and is a continuation-in-part of application Serial Number 780,074, filed October 15, 1947, issued into Patent No. 2,578,101.

In Fig. 1, numeral 19 designates a combustion type burner having a body 20 of refractory material shaped to define a combustion chamber 21. The rear end of the combustion chamber 21 is provided with a wall 22 having a plurality of restricted orifices extending therethrough, and the opposite end of the chamber is provided with a front wall having an outlet or discharge opening 23. The refractory body 20 is enclosed in a sheet metal shell

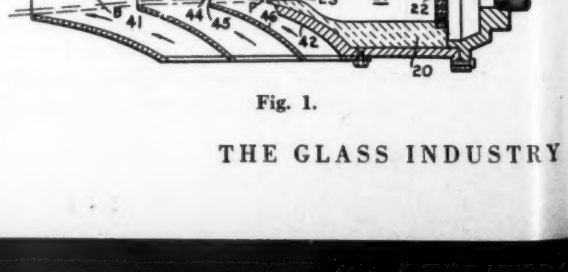


Fig. 1.

24 which extends beyond the rear end of the body in a manner to form an inlet chamber or manifold 25 at the rear side of the perforated wall 22. A conduit 26 is connected at one end to the rear end of the shell for feeding the specified combustible gaseous mixture into the inlet chamber 25.

The glass or other heat softenable material selected is fed into the blast B in the form of primary filaments or solid rods P. A plurality of primary filaments are fed into the blast B along a path extending substantially perpendicular to the blast and are arranged with adjacent filaments spaced laterally from each other crosswise of the blast. The velocity and temperature of the blast is highest immediately adjacent the outlet opening 23 in the front wall of the burner and decreases in both temperature and velocity as the distance from the outlet opening increases. Thus in order to take full advantage of the maximum temperature and velocity of the blast, the primary filaments P are fed into the blast as close to the outlet opening 23 as is practical. In actual practice it is ordinarily desirable to increase the effective attenuating length of the blast B as much as possible so that the glass streams in the blast are maintained in a molten or softened condition for a greater portion of their length and, as a result, are more effectively drawn out or attenuated by the force of the blast. Thus finer fibers may be produced at greater quantities from primary filaments of larger diameter.

The patent contains four claims and the following references were cited: 2,569,699, Stalego, Oct. 2, 1951 and 2,578,101, Stalego, Dec. 11, 1951.

Green Ophthalmic Glass. Patent No. 2,699,399. Filed February 18, 1952. Issued January 11, 1955. No drawings. Assigned to Corning Glass Works by William H. Armistead.

When green spectacle crown glass is utilized for making multifocal ophthalmic lenses, it is desirable that the high-index segments be composed of a flint glass because, generally speaking, flint glasses not only have the requisite high refractive indices, but also have the desirably lower softening points which are necessary in order to avoid distortion of the crown glass when the former are sealed. For such use it is also desirable that the flint glass have a color exactly or substantially exactly matching that of the green spectacle crown. The glass compositions below calculated from their respective batches have provided good results.

The patent contains eleven claims and the following references were cited: 2,523,266, Armistead, Sept. 26, 1950 and "Rx Lenses," American Optical Company Catalog, page 64, published in 1950.

Acid Treatment of Glass Fabric, Prior to Lamination. Patent No. 2,700,010. Filed July 5, 1951. Issued January 18, 1955. Three sheets of drawings (none reproduced). Assigned to Glass Fibers, Inc. by Emil H. Balz.

This invention relates to glass fabric and its treatment to render the same suitable for the formation of laminates with other materials. More particularly, the invention relates to methods of preparing glass fabric for lamination with resin compositions. All types of glass compositions, such as E and T glass, which are useful in the production of glass fibers, are suitable for the practice of the invention.

The process includes the removal of the binder material from glass cloth and hydrolysis of the glass surface with strong alkali. A preliminary acid treatment is also given to condition the surface of the glass cloth, a treatment with an agent such as chrome complex to render the acid treated surface of the glass particularly suitable for the receipt of resinous materials and the application of the resin. It is not necessary in all instances to apply the chrome treatment as many resins, such as the curing type silicones, laminate readily with the acid treated hydrolyzed glass surface.

The patent contains six claims and the following references were cited: 2,184,320, Simpson, Dec. 26, 1939; 2,383,469, Colbert et al., Aug. 28, 1945; 2,407,483, Ebaugh, Sept. 16, 1946; 2,433,292, Perloff, Dec. 23, 1947; 2,552,910, Steinman, May 15, 1951; 2,563,288, Steinman, Aug. 7, 1951; and John Wiley & Sons, Deming-General Chemistry 1935, 4th edition (only pages 530-533 relied upon).

Sheet and Plate Glass

Tempered Glass Sheet Provided With a Transparent Electrically Conducting Film. Patent No. 2,698,261. Filed November 13, 1951. Issued December 28, 1954. Three sheets of drawings (none reproduced). Assigned to Libbey-Owens-Ford Glass Company by Romey A. Gaiser.

	1	2	3	4	5	6	7	8	9
SiO_2	50.1	37.8	37.6	45.7	41.1	45.3	39.2	45.8	39.4
K_2O	5.2	....	4	6.5	4.5	4.4	....	....	....
Na_2O	5	7.6	1.8	2.1	2	5.5	7.9	6.5	6.5
Li_2O	....	....	....	....	....	....	....	2	....
CaO	....	....	....	....	....	....	5	5	5
Zno	....	....	....	....	....	....	....	7.1	7.5
BaO	....	15	....	....	....	....	20	20	19.5
PbO	37.7	30	52.3	44.8	42.4	39.8	14	....	....
B_2O_3	....	4	....	....	....	....	3.5	4	5
Al_2O_3	2	....	0.2	0.4	....	2	....	....	....
TiO_2	....	....	3.8	....	....	....	3	2.2	8.9
ZrO_2	....	5.2	....	....	....	3	7.3	7	7
Sb_2O_3	0.4	0.5	0.3	0.6	10	0.2	0.5	0.8	1
Cr_2O_3	0.176	0.14	0.057	0.41	0.14	0.10	0.09	0.05	0.25
Nio	0.0425	0.08	0.03	0.11	0.07	0.024	0.05	0.028	0.145
CoO	0.0025	0.008	0.010	0.011	0.010	0.0014	0.005	0.0028	0.015
Refractive index, ^nD	1.588	1.653	1.700	1.616	1.653	1.616	1.653	1.616	1.664
Softening point, °C	626	633	593	619	600	632	686	664	731
Color (Shade)	B	C	B	D	C	A	B	A	D

It is an important aim of the present invention to produce a sheet or plate of glass that is filmed with a transparent electrically conducting film and which, at the same time, will exhibit mechanical strength and breaking characteristics under predetermined pressure loads that are as good as, if not better than, those of fully heat treated, or "full tempered" glass. The important points are, when transparent, electrically conducting films are to be produced that the glass be heated to substantially its point of softening, that the two surfaces of the heated sheet be treated substantially simultaneously, one by a moving, non-filming fluid and the other by moving sprays of filming fluid, for a sufficient length of time to produce the desired thickness of film on one surface and the desired degree of temper at both surfaces, and, preferably, that there be a definite time lapse between the heating, and the filming and final strengthening treatments. Different filming fluids can be employed, such as solutions of various tin halides, and even vapors of filming materials such as stannic tetrachloride, stannic tetraiodide, stannic tetrabromide, etc., all of which can be sprayed on hot glass to produce transparent, electrically conducting films. Furthermore, non-filming fluids in liquid, semi-liquid or gaseous form can be used instead of air to chill the unfilmed surface of the glass. Examples of these are steam, oil and mists of water-oil emulsions.

The patent contains one claim and the following references were cited: 2,194,611, Paddock et al., Mar. 26, 1940; 2,236,911, Long, Apr. 1, 1941; 2,311,846, Littleton et al., Feb. 23, 1943; 2,564,707, Mochel, Aug. 21, 1951; and 2,584,859, Gaiser, Feb. 5, 1952.

Simultaneous Grinding of Two Faces of a Glass Sheet. Fig. 2. Patent No. 2,699,021. Filed March 16, 1953. Issued January 11, 1955. Two sheets of drawings. Assigned to Les Glaceries de la Sambre Societe Anonyme by Edmond Laverdisse.

The present invention, as shown in Fig. 2, relates to the feeding of abrasive composition to the irons; that is to say, to the discoidal tools employed for grinding rough glass. The essential feature of the present invention resides in that the abrasive introduced into the interior of the tool is directed from a central point relatively distant from the working plane of the shoes, in the direction of the plane, along an inclined path progressively approaching the working surface of the first ring of shoes. For this purpose, in the lower tool, the feed duct 4 has formed lateral orifices 19 through which the abrasive passes, the abrasive falling from the overflow edge 20 on to the plate 21 forming the base of the tool with which it turns. The centrifugal force impels the abrasive through the radial ducts 22, which open into slots 23 at the base of circular grooves 10 more or less distant from the center according to requirements. The orifices 19 are so calibrated as to permit the passage of only a limited quantity of abrasive, the remainder being fed through radial nozzles 24 directed along the conical base of the cavity 6, whence the abrasive falls between the blades 8. In the upper tool, the abrasive fed through the tube 4′ is distributed between the peripheral orifices 26 from which it falls over the overflow 20′ on to the rotating plate 21′ formed with radial ducts 22′, and the calibrated orifice 27, from which it falls on to the cone 13 which, with the blades 8′, constitutes the impeller.

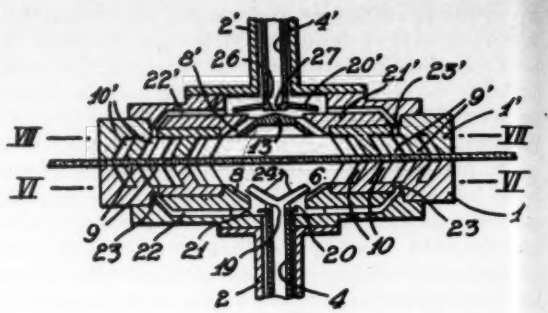


Fig. 2.

The patent contains 14 claims and the following references were cited: 696,195, Rogers, Mar. 25, 1902; 1,856,173, Stahle, May 3, 1932; 1,924,597, Drake, Aug. 29, 1933; 2,179,740, Griffin, Nov. 14, 1939; and 2,264,177, Harrington, Nov. 25, 1941.

Tube and Cane Machines

Method of Manufacturing Cathode Ray Tubes. Patent No. 2,695,477. Filed October 21, 1950. Issued November 30, 1954. One sheet of drawings (none reproduced). Assigned to Hartford National Bank and Trust Company by Otto Louis van Steenis.

In cathode ray tubes of the kind comprising a glass cone, the weakest area is found in the transition zone between window and cone. If a separate glass window is sealed to a glass cone, the difficulty arises that the seal between window and cone is then located precisely in the critical zone, i.e., at the area of the greatest strains. This may be avoided by providing the seal outside the transition zone, for example by using a window with an upright edge. The seal is then located in the peripheral surface outside the rounding of the transition zone between window and cone. The cone and the window are slightly separated during the sealing of the edges so that the seal becomes located in the peripheral surface of the cone and beyond the bend of the transition zone between window and cone. Consequently, the starting material may then be slightly spherical, flat glass plate, the edges of which have not been subjected to special treatments, such as are required for the provision of an upright edge, although the advantages attendant on the use of such a spherical window are nevertheless obtained.

The patent contains one claim and the following references were cited: 2,160,434, Harris, May 30, 1939; 2,215,644, Hays, Jr., Sept. 24, 1940; 2,236,708, Grimditch, Apr. 1, 1941; 2,334,123, Perkins, Nov. 9, 1943; 2,389,360, Guyer et al., Nov. 20, 1945; 2,581,945, Doran, Jan. 8, 1952; and 536,858, Great Britain, May 29, 1941.

Apparatus For and Method of Forming Glass Articles Having Funnel-Tube Configuration. Patent No. 2,699,013. Filed January 12, 1953. Issued January 11, 1955. One sheet of drawings (none reproduced). Assigned to Corning Glass Works by Lloyd C. Hopkins, Herman H. Schrickel, Jr. and Vernon L. Wainwright.

In accordance with this invention, a tubulated glass article can be produced as an integral unit in a single operation by fabricating the article with the aid of centrifugal action. A charge of molten glass is deposited in a hollow mold provided with a tubular portion, and the mold is rotated about the axis of its tubular portion to centri-

fugally distribute molten glass over the walls. Advantageously, the mold is arranged with its tubular portion vertical, and the glass charge is initially positioned over the mouth of the tubular portion. A differential pressure, preferably obtained at least in part by the creation of a negative pressure within the tubular portion, is ordinarily applied to the glass charge to force a controlled amount of molten glass into the tubular portion for formation of the desired tubulation. A glassworking tool referred to as a distributor is also advantageously introduced into the tubular portion to effect annular extrusion and distribution of the glass forced thereinto, desirably in cooperation with a valve which occupies such tubular portion and is so withdrawn as to subject the glass during its advancement to a yieldingly opposing pressure. Provision can readily be made for obtaining the necessary mold speed to attain this object for a given glass viscosity, but the continued maintenance of the required glass viscosity is more difficult. This difficulty can be substantially mitigated and a greater latitude of glass viscosity variation can be tolerated by utilization of the distributor as it is being returned to its initial position as a sizing or marvering tool for sufficiently thinning the funnel-tubulation junction wall area while the funnel-tube is still being rotated and while the glass in such area is still soft.

The patent contains 16 claims and the following reference was cited: 1,859,957, Canfield, May 24, 1932.

Method of Manufacturing Cathode Ray Tubes Comprising a Glass Cone and a Glass Window. Fig. 3. Patent No. 2,699,014. Filed April 23, 1953. Issued January 11, 1955. One sheet of drawings. Assigned to Hartford National Bank and Trust Company by Otto L. van Steenis.

This invention relates to methods of manufacturing cathode ray tubes comprising a glass cone and a glass window. After sagging of the glass plates, the glass edges are heated and dies 7 and 8 (not shown) are introduced into the cavities. In this manner the glass parts acquire the correct shape, the edges being forced upwards and engaging the dies. The dies are subsequently removed, the cone 4 is heated at its narrow end and pierced at 14. After that the molds are swung upwards, for example about pivots 12 and 13, till the edges of the cone and of the window face each other, as shown in Fig. 3. By evacuating the ducts 9 and 10, the glass parts are maintained in the molds. Subsequently the molds are jointly rotated and the edges sealed together by means of burners 15. If the sealing edge tends to sag inwards, compressed air may be blown into the duct 11 so that the sealing edge is slightly forced outwards. After cooling, the assembly of cone and window is further processed in the usual manner, the neck being sealed to the narrow part 14 of the cone and the luminescent layer being provided on the window.

The patent contains two claims and the following references were cited: 419,441, Henning, Jan. 14, 1890; 544,248, Cutler, Aug. 6, 1895; 2,570,309, Black, Oct. 9, 1951; and 654,705, Great Britain, June 27, 1951.

Apparatus for Forming the Ends of Glass Tubes. Fig. 4. Patent No. 2,699,630. Filed May 1, 1951. Issued January 18, 1955. Nine sheets of drawings. Assigned to Lumalampan Aktiebolag by Karl M. Alm and Bror E. Oghammar.

This invention relates to glass working and more particularly to a device for shaping the ends of glass tubes while they are rotating about their axes and to a machine equipped with a plurality of such devices for increased production. The machine shown is intended for end-shaping of luminous tube envelopes, not only of varying diameters, but also of varying length.

The clamping device to the right with burners, cutting-off device and end-shaping device is therefore arranged so that it can be moved to different positions along the main shaft. For this purpose, a longitudinal key is attached, and the sleeve 25 for disc 27 supporting tube holder 30 is provided with a keyway in engagement with this strip. The sleeve can thus be moved without turning the support for the tube holder in relation to the main shaft. Sleeve 25 is fastened to the shaft by means of locking bolts 194. The hub which supports end-shaping unit 100′ and flange 87 with the cutting device and the burners (Fig. 4) to the right, is journalled on sleeve 25 and is held axially in position between disc 27 and stop ring 180 (not shown)

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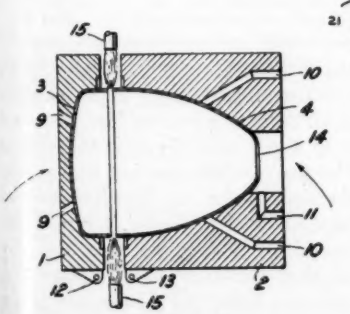


Fig. 3.

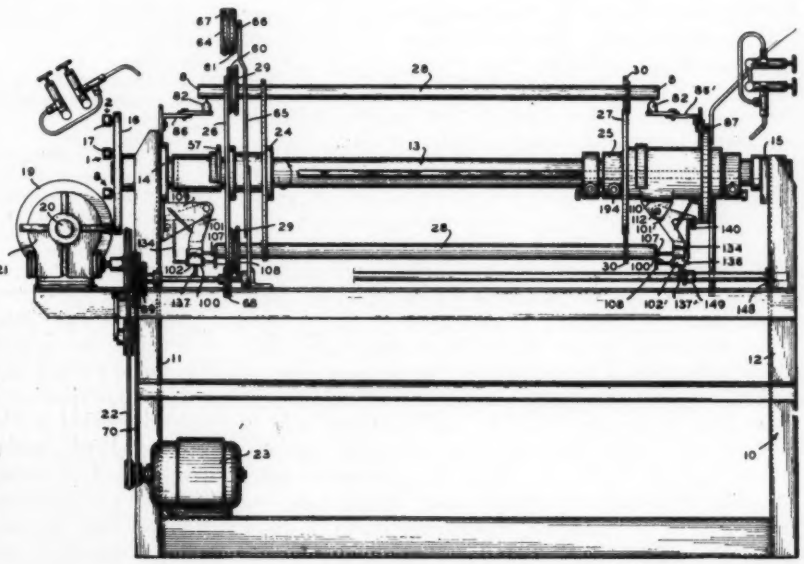


Fig. 4.

Report on a New Post-War Furnace

The Society of Glass Technology (England) has several technical committees which actively pursue work on several subjects. Two of these committees are the Furnace Committee and the Joint Fuel Efficiency Sub-Committee. During meetings of these two committees, many features of design and operation have been discussed, and most of them have been tried and proved in many different furnaces. The war period, with its fuel and melting problems, gave a great impetus to the work. Accordingly, when new furnaces were installed just after the war, there was available a considerable store of information which, if used, could have resulted in units of substantially improved efficiency. W. A. Moorshead, in the October 1954 issue of the *Journal of the Society of Glass Technology*, reports on the results of one such furnace, in the design of which a real attempt was made to introduce some of the lessons of many years of collaboration with other workers in the same field.

First, a summary was given of the lessons as they were learned: (a) Furnaces can melt well, without raising temperatures, at much greater rates than was at one time imagined, or than was the usual practice. This means, of course, building a new furnace with a melting area smaller than would have been considered advisable previously. For example, a furnace for a maximum output of 67 tons (2000 lb. ton) glass melted per 24 hrs. might have been designed before the war with a melting area of 540 or 600 sq. ft. Now the melting area should be made about 420 sq. ft., or at least 20% smaller. Naturally, the area required depends on how much "seed" can be tolerated. If it is to be less than that required for first-class bottle glass, a larger area might be necessary.

(b) A wide furnace (width nearly equalling the length) is better than a rectangular furnace because of the longer flame path resulting. Also, heat losses per sq. ft. of melting area are reduced.

(c) Ports must give good mixing, which means that the air and gas should meet at right angles, and their size should be generally longer than was pre-war practice.

(d) Regenerators should be as tall as possible and insulated.

(e) The insulation of crowns is entirely safe and, with it, a very real fuel saving is obtained.

(f) Waste-heat boilers are more than worthwhile if certain precautions are taken in connection with their installation.

(g) End-firing is more efficient than cross-firing, without qualification as to the size of the furnace. This is probably due to two main factors: (1) a much longer flame path is provided and (2) port heat loss area is reduced, there being only two ports instead of, say, six.

(h) The cross-flow regenerator system seemed to offer attractive advantages over the usual vertical-type regenerator. In a cross-flow regenerator there is more efficient use of the regenerator space; both higher velocities and a longer time for heat exchange result. Also, the gravitational flow of slag from hot to cooler parts of the regenerator is prevented so that choking does not occur, with the result that the full efficiency of regeneration should be maintained over a longer period. In this type of regenerator, heat losses should be reduced appreciably so that gases at a higher temperature should be available for use in a waste-heat boiler without sacrifice of air pre-heat temperature.

(i) The regeneration of producer gas seemed to serve little or no useful purpose.

(j) A waste-heat boiler seemed to offer advantageous possibilities of being a vital and integral part of the furnace system instead of being merely an added appendage.

Higher temperatures is another answer to higher efficiencies. With higher flame and furnace temperatures, the rate of heat transfer to the melting glass is increased and this enables higher outputs to be obtained. Higher outputs (represented by more than 67 tons glass per 24 hrs. in a 420 sq. ft. furnace) are being obtained by the high temperature technique, and this has so far always given an improved glass/fuel ratio even though wall losses have been substantially increased. Higher temperatures are bound up with the refractories problem and this imposes a definite limit on temperatures. In this connection, one should incline towards safety; that is, with the now commonly used superstructure refractories (English practice?), a furnace should be designed to work at no more than about 2660°F. This fixes the maximum melting rate at about 1 ton of glass/24 hrs. on 6.7 sq. ft. of melting area, and at the present time this, it is suggested, is a reasonable starting point in the design of any new furnace.

Table 1.

Worksop End-fired Furnace

Melting end, 18 feet wide, 20 feet long	348 sq. ft.
Working end	74 " "
Total area	422 " "
Regenerator packing space, each regenerator	1050 cu. ft.
Cross-sectional area of openings:	
Top pass	16 sq. ft.
Bottom pass	14 " "
Length of passage through regenerator, two passes together	29 feet
Packing one regenerator	33.6 tons
Heating surface, each regenerator	5020 sq. ft.
Temperature, regenerator exit (average)	1290° F.
Temperature, waste-heat boiler inlet (average)	1070° F.
Temperature, waste-heat boiler outlet (average)	390° F.

At the C.W.S. Glass Works, Worksop, early in 1946, a decision had to be taken on the design of an entirely new furnace and with all the above lessons fresh in mind and a determination to apply them in full, the design decided itself: (a) The shape of the melting end was to be as square as practicable. (b) An end-fired furnace and not a cross-fired furnace had to be adopted, not only because of the evidence of its advantages, but also because it was desired that the cross-flow regenerative principle should be given a trial. (c) There was to be

(*Continued on page* 444)

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during May 1955 was as follows: *Flat Glass:* A preliminary figure of 28,600 for May indicates a drop of only .3 per cent from the adjusted 28,700 reported for April. *Glass and Glassware, Pressed and Blown:* An increase of 1.9 per cent is shown by the preliminary May figure of 78,900 when compared with April's 77,400. *Glass Products Made of Purchased Glass:* The preliminary 14,700 indicates a drop of only .6 per cent from the previous month's 14,800.

Payrolls in the glass industry during May 1955 were as follows: *Flat Glass:* An increase of 4.9 per cent is shown in the preliminary $14,361,395 when compared with April's adjusted $13,690,283. *Glass and Glassware, Pressed and Blown:* An increase of .8 per cent is shown in the preliminary $25,054,432 reported for May when compared with the previous month's adjusted $24,836,370. *Glass Products Made of Purchased Glass:* A preliminary figure of $4,110,561 was reported for May. This is 3 per cent higher than the adjusted April figure of $3,990,376.

GLASS CONTAINER SHIPMENTS
(All Figures in Gross)

	June 1955
Narrow Neck Containers	
Foods	1,176,000
Medicinal & Health Supplies	1,133,000
Chemicals, Household & Industrial	848,000
Beverages, Returnable	1,367,000
Beverages, Non-returnable	143,000
Beer, Returnable	454,000
Beer, Non-returnable	828,000
Liquors	833,000
Wines	334,000
Toiletries & Cosmetics	847,000
Sub-total (Narrow)	7,963,000
Wide Mouth Containers	
Foods	*3,061,000
Dairy Products	213,000
Medicinal & Health Supplies	355,000
Chemicals, Household & Industrial	150,000
Toiletries & Cosmetics	156,000
Packers' Tumblers	165,000
Sub-total (Wide)	4,100,000
Total Domestic	12,063,000
Export Shipments*	267,000
TOTAL SHIPMENTS	12,330,000

* This figure includes Fruit Jars and Jelly Glasses.

GLASS CONTAINER PRODUCTION AND INVENTORY
(All Figures in Gross)

		Production June 1955	Stocks June 1955
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck ...	4,131,000	4,878,000
	Wide Mouth ..	*3,879,000	*4,988,000
Dairy Products		212,000	342,000
Beverages, Returnable		1,297,000	1,216,000
Beverages, Non-returnable		160,000	247,000
Beer, Returnable		408,000	305,000
Beer, Non-returnable		816,000	801,000
Liquors		832,000	882,000
Wines		329,000	488,000
Packers' Tumblers		155,000	180,000
TOTAL		12,219,000	14,327,000

* This figure includes Fruit Jars and Jelly Glasses.

Glass container production, based on figures released by the Bureau of Census, rose 3.8 per cent during June to reach 12,219,000 gross. This is an increase over the previous month's 11,758,000 gross. During June 1954, production was 11,219,000 gross, or 8.9 per cent below June this year. Glass container production at the end of the first six months of 1955 has reached a total of 66,859,000 gross, which is 4.4 per cent ahead of the 63,993,000 gross produced during the same 1954 period.

Shipments of glass containers during June increased 3.9 per cent to reach 12,330,000 gross. This is an increase over May shipments which were 11,856,000 gross. Shipments during June 1954 were 11,162,000 gross, or 10.4 per cent above June 1955. At the end of the first six months of 1955, glass container manufacturers have shipped a total of 65,055,000 gross, which is 6.5 per cent ahead of the 61,062,000 gross shipped during the corresponding period last year.

Stocks on hand at the end of June 1955 were 14,327,000 gross. This is only slightly under May stocks of 14,331,000 gross and 4.5 per cent higher than the 13,708,000 gross on hand at the end of June 1954.

Automatic tumbler production during May 1955 was 5,647,414 dozens. This is a drop of 1.3 per cent from April production which was 5,724,878 dozens. Production during May 1954 was 5,650,544 dozens. Shipments during May 1955 rose to reach 5,618,054 dozens. This is 6.9 per cent higher than April's 5,254,649 dozens. During May 1954, shipments were 6,225,429 dozens. At the end of the 12-month period ending May 1955, shipments have reached a total of 61,507,327 dozens, which is 1.2 per cent higher than the 60,721,211 dozens shipped last year.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and household glassware during May fell off 8 per cent to reach 2,834,307 dozens. This is a drop from April's 3,083,675 dozens. During May 1954, sales were 2,987,257 dozens. At the end of the 12-month period ending May 1955, manufacturers had sold a total of 37,541,765 dozens, which is only slightly above the 37,518,463 dozens sold during the corresponding 1954 period.

ROBERT F. RIDDLE RETIRES

Pennsylvania Glass Sand Corporation has announced the retirement of Robert F. Riddle at the age of 65.

After attending Pennsylvania State University, Mr. Riddle spent two years in Europe with the United States Air Corps during the First World War. He joined Pennsylvania Glass Sand in 1922.

CONFERENCE HELD ON REHABILITATION FOR GLASS HOUSE POINT

A joint meeting of the contributors to the rehabilitation for Glass House Point, Jamestown, Virginia, and members of the National Park Service was held on July 15 in Washington, D. C. C. W. Gustkey, President of Imperial Glass Corporation, was Chairman of the Organizing Committee for the "Restoration of Glass House Point" for both Glass Crafts of America and American Glassware Association.

Following Mr. Gustkey's opening remarks, W. F. Dalzell, President of Fostoria Glass Company and a member of the Organizing Committee, gave a historical review of activities leading up to the meeting. Mr. Gustkey then discussed the necessity of forming a corporation to work in connection with the National Park Service in the further development of the restoration of the first glass plant and the authenticated first industry in America located at Glass House Point. The necessity for forming such a corporation to handle the affairs of the contributors and their contact with the National Park Service was recognized by all present.

C. W. Gustkey

Upon motion of R. B. Tucker, Executive Vice President of Pittsburgh Plate Glass Company, seconded by A. Votero, American Flint Glass Workers Union, it was unanimously voted to incorporate a non-profit, educational, charitable and historical preservation institution, with suitable offices as would be required under the public laws, preferably in the state of Virginia, or any other state that would, in the opinion of the Board of Directors, best serve the interests of the group.

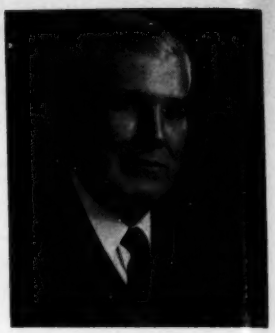
After pertinent questions by a few of those present and upon motion of Mr. Tucker, seconded by C. T. Heisey, President of A. H. Heisey & Company, it was unanimously voted for officers and directors of the new corporation to enter into a contract with the National Park Service for the development and operation of the plant to be located at the site of the first glass plant.

J. C. Harrington gave a summary of the progress of restoration plans which would assure that the project would be open when the Jamestown celebration opens on April 1, 1957, and to be in operation to October 19, 1957.

Budget problems were then discussed and Mr. Dalzell presented details which indicate that there would be ample funds collected from industry to assure operations at the plant through the celebration year. It was unanimously voted that the proposed budget be turned over to the executive committee for further refinement and guidance on a motion by Mr. Heisey, seconded by C. T. Swartling, President-Treasurer of Viking Glass Company.

A second session of the meeting was held the evening of July 15 at which officers and directors were elected. Elected as officers for the new corporation were Carl W. Gustkey, President; W. F. Dalzell, Vice President; and R. B. Tucker, Secretary and Treasurer. Elected to the Executive Committee were William H. Blenko, President of Blenko Glass Company, Inc.; Mr. Dalzell; Mr. Gustkey; Mr. Tucker; and Albert Votero. The directors for the new corporation are Richard H. Andrews, Executive Director, Corning Glass Works Foundation; J. M. Ashley, Director of Public Relations, Libbey-Owens-Ford Glass Company; William H. Blenko; Harry H. Cook, President of the American Flint Glass Workers Union; Mr. Dalzell; Edwin D. Dodd, Production Manager, Libbey Glass Division, Owens-Illinois Glass Company; George Dougherty, American Glassware Manufacturers, Inc.; J. Fletcher Gillinder, President, Gillinder Brothers, Inc.; Mr. Gustkey; Mr. Heisey; Mr. Tucker; and John C. Weber, Jr., West Virginia Glass Specialty Company.

W. F. Dalzell



R. B. Tucker

Among the several Government officials attending and who gave recognition responses to their introduction were H. B. McCoy, Deputy Administrator, B.D.S.A., Department of Commerce, and Secretary of the Interior, Douglas McKay.

NORTHWESTERN OHIO A.C.S. SECTION TO MAKE AWARD

The Northwestern Ohio Section of the American Ceramic Society has announced its intention to honor outstanding contributions and distinguished achievements in the glass and other ceramic industries by establishing "The Toledo Glass and Ceramic Award."

The award will be made annually and the recipient will be asked to deliver an address at the meeting at which the award is made. An Award Committee will consist of six appointive members of the Northwestern Ohio Section, together with the Trustees of the Glass Division of the Society.

All nominations for the first Toledo Glass and Ceramic Award should be directed to L. V. Gagin, Libbey-Owens-Ford Glass Fibers Company, Waterville, Ohio, not later than September 1, 1955.

WALSH APPOINTS GLASS REPRESENTATIVE

The appointment of J. S. Tuttle to represent the glass division of Walsh Refractories Corporation in the Pittsburgh area has been announced by J. J. Duggan, Vice President.

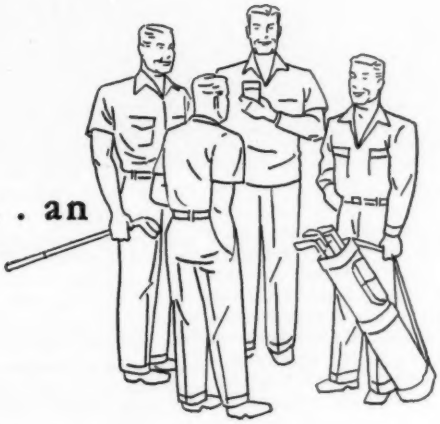
With a background of over 40 years experience in the glass refractory industry, Mr. Tuttle's career began in 1911 with the Willets Company, where he remained until 1923. In 1924, he joined the Glass Refractories Division of Laclede-Christy Company, which position he held until his recent affiliation with Walsh.

. . . . . a ***refresher*** course

in mould irons and mould making . . . and an introduction to much that's new. You'll profit from clinics and discussions.

. . . a ***relaxing*** day

to talk and laugh and golf. You'll meet old friends in the glass industry . . . and make new ones.



. . . an ***r.s.v.p.*** invitation

to attend this annual get-together will be sent you soon. We hope you'll be with us . . . and that you'll return your reservations promptly.

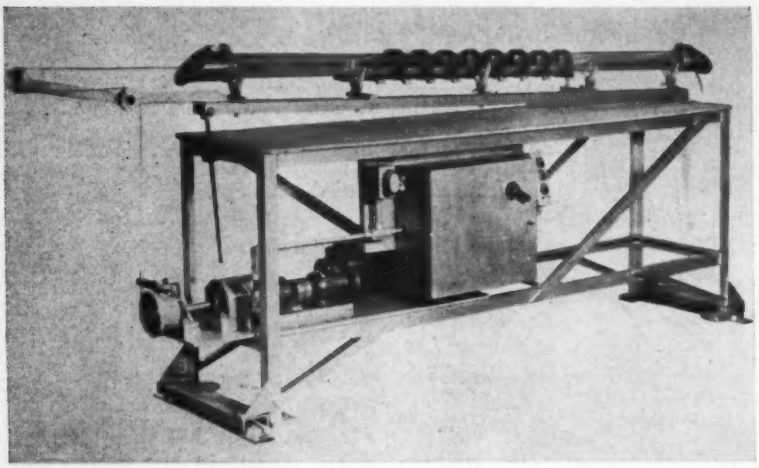
THE SEVENTH ANNUAL

Overmyer Iron Clinic

Thursday, Sept. 22, 1955 • Winchester, Indiana

THE OVERMYER MOULD COMPANY, INC., Winchester, Indiana

New Equipment and Supplies



KAHLE CRYSTAL PURIFYING MACHINE

Kahle Engineering Company, North Bergen, New Jersey, has developed a new machine for refining and purifying crystals used in the production of transistors.

The machine uses the zone refining method for purifying such elements as germanium and silicon. It can also be used for zone levelling. It is available in a wide range of sizes, featuring adjustable incline and speed, thyratron control, quick return, shock mounting and gas atmosphere.

The new Kahle machine is available in two types. In one model, the crystal is drawn through the H. F. coils, and in the other, the crystal is stationary and the H. F. coils are traversed.

ROTARY CODER

Krengel Manufacturing Company, Inc., 227 Fulton Street, New York 7, New York, has made available its Krengel rotary coder which automatically prints names, dates, codes or other identification. Powered by a friction roller attachment, the rotary coder imprints on boxes, cartons, packages, cases, or any kind of surface. Its self-inking feature assures a clear, clean, sharp impression. Krengel's baselock interchangeable rubber type is available in all point sizes and fonts, in sets of letters or figures, deep cut for sharpness and long service.

PORTABLE PYROMETER

Robertshaw-Fulton Controls Company, Fielden Instrument Division, 2920 North Fourth Street, Philadelphia 33, Pa., has announced the development of its land surface pyrometer for accurately measuring high temperatures of refractories and metals when surrounded by cooler air.

According to the company's announcement, the instrument will give accurate temperature readings within 0.5 per cent, whereas contact thermocouples, formerly relied upon for measuring heated material in cool surroundings, have an accuracy of about 5 per cent. The new pyrometer is suitable for measuring "spot" temperatures in a range from 100°F. to 2400°F.

Temperature readings of high accuracy are made possible by the instrument's design which, according to the company, produces near-perfect "black body" radiation. Applied to the surface of a hot body, the instrument head closes off a portion of the heated material, forming a uniform temperature enclosure. A near-perfect reflector, created by a heavy gold plating inside the instrument head, actually reproduces the surface conditions of the hot material. "Black body" radiation trapped within the uniform temperature enclosure is then sampled through a small fluorite window, which is transparent to most of the infrared spectrum and measured by a sensitive thermopile. Used in determining the temperature of refractories, the depth of measurement is about 1/16-inch below the surface.

BAUSCH & LOMB MACROSCOPE

Bausch & Lomb Optical Company, Rochester 2, New York, has developed a macroscope which provides an erect, unreversed image useful in production line operations, inspection and quality control.

Magnifications of 10X, 20X or 40X are available. Because the macroscope provides a normal, erect image and focuses simply by sliding in its holder, operators do not have to be specially trained. Inspection procedures are speeded because of the unusually wide area visible through the instrument's optical system. Working distance between the optical tube and the object under study is long enough to permit easy movement of irregularly shaped pieces or the macroscope itself. Precise measurements of objects under the macroscope are possible with scales, which are available as accessories.

HIGH-SPEED RECORDING POTENTIOMETER

The Bristol Company, Waterbury 20, Conn., has announced a recording wide-strip potentiometer which features full-scale pen travel in only 0.4 seconds.

The pen of the high-speed electronic dynamaster recorder makes the traverse across the 11-inch chart scale in 0.4 of a second without overshoot at the end. The "deadband" of the instrument is less than 0.1% of the full-scale span. It is offered with standard ranges as low as 1 millivolt for full scale, with source resistance up to 10,000 ohms.

HAYS ELECTRONIC FLOW METERS

The Hays Corporation, Michigan City, Indiana, is offering a choice of several mercury-less transmitters with its electronic flow meters for measurement of differential pressures; liquid level; fluid, gas, air or steam flow; temperatures and pressures.

Features are six counter continuous integration, 12-inch uniformly graduated charts and choice of several style indicators. Combination of flows or flow and level can be recorded on the same chart.

SONIC ANALYZER

Kinetic Instrument Company, Highland Park, Illinois, has developed a sonic analyzer for non-destructive testing of solid and visco-elastic materials called the E-Scope.

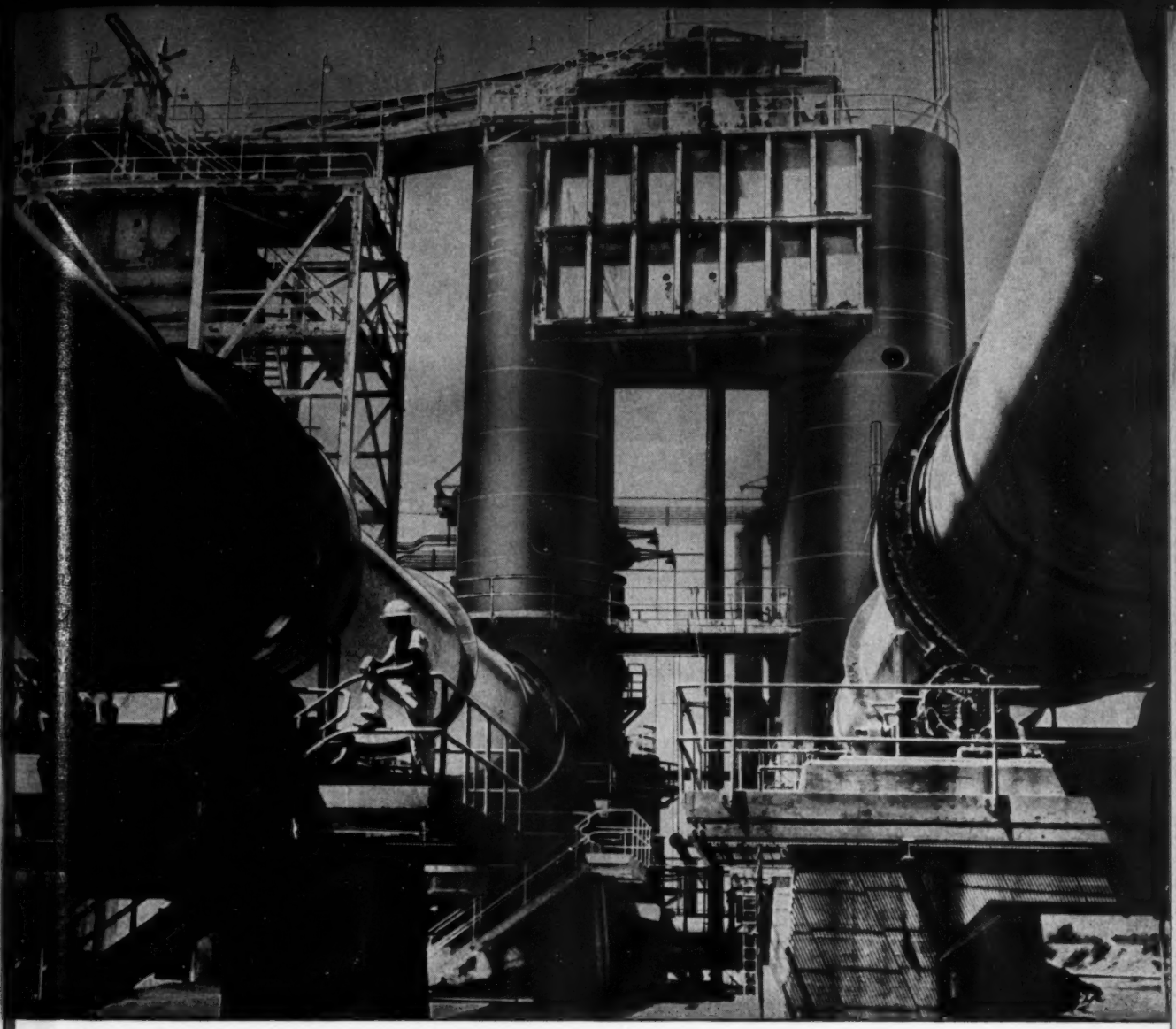
Featuring unusual accuracy, portability and operating convenience in providing measurement of effects of natural or induced deterioration, flaws or inclusions, or product uniformity, the instrument is self-contained and is designed for laboratory use, field testing or production quality control. The E-Scope permits sonic testing of glass, plastics, graphite, brick, ceramics, etc.

ROLLING GLASS HARDWARE

Designware Industries, 464 Roy Street, St. Paul 4, Minnesota, is producing a new type of glass hardware for china cabinets, display and show cases, etc.

Glass doors ride in extruded aluminum shoes equipped with press-fit nylon wheel assemblies that roll silently on raised removable rails. All shapes are of extruded aluminum and are fur-

(*Continued on page* 436)



Mathieson Soda Ash: *there's always an 'r' in purity*

Purity knows no season in the production of Mathieson soda ash; oyster *shells* are available every month of the year. Here at Lake Charles, La., shells are the starting point of the ammonia-soda process. Taken from the Gulf by the thousands of tons, they are washed and placed in huge storage piles, then transferred as needed to the towering silos shown above. From the silos they are fed into large rotary kilns where carbon dioxide and lime of extremely high purity are obtained.

At *all* Mathieson plants, attention to raw materials helps assure the quality of products. In addition, buyers have the protection of multi-plant production facilities... 2 soda ash plants, 6 caustic soda plants, 5 chlorine plants, 7 sulphuric acid plants, 3 ammonia plants... plus practical technical assistance with materials handling and application problems. When planning current or future chemical requirements, be sure to call on Olin Mathieson. Perhaps you can buy to better advantage from one of America's largest, most diversified producers of basic industrial chemicals.

MATHIESON CHEMICALS
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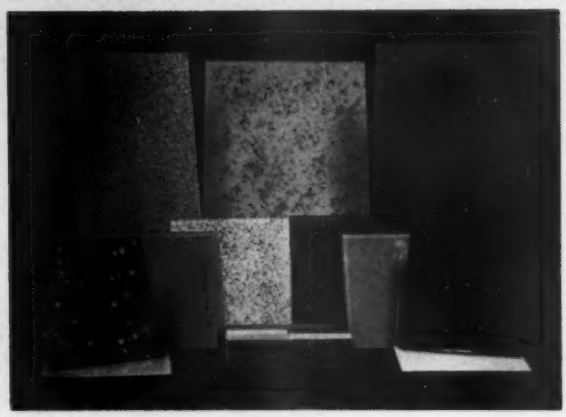
2851A

CAUSTIC SODA • SODA ASH • CHLORINE • SULPHURIC ACID • SULPHUR • AMMONIA • NITRATE OF SODA • BICARBONATE OF SODA • CARBON DIOXIDE • SODIUM CHLORITE • CALCIUM HYPOCHLORITE
ETHYLENE OXIDE • ETHYLENE GLYCOL • DIETHYLENE GLYCOL • TRIETHYLENE GLYCOL • POLYGLYCOLS • DICHLOROETHYLETHER • ETHYLENE DICHLORIDE • METHANOL • SODIUM METHYLATE • ETHYLENE DIAMINE



PPG ANNOUNCES "SPANDRELITE"

Multi-colored glass buildings in jewel-like tones and textures are now possible with the development of a new true glass building product introduced by Pittsburgh Plate Glass Company. The new building material will be known as "Spandrelite."

"Although it is true glass composition throughout, Spandrelite is strong, tough and remarkably resistant to shock," according to Wallace R. Harper, Vice President. "The heat-strengthening process which fuses ceramic color to the plate glass base gives the entire structure far greater shock resistance than ordinary plate glass of the same thickness," he said.

Initial manufacture will be in panel sizes up to 48″ x 84″. In addition to custom colors, ranging from pastels to chartones, and textures from polished to tapestry, eight standard colors will be provided in a choice of polished plate glass or twill textures in opaque finishes.

Unlike surface coatings used on many building panels at the present time, Spandrelite color is said to be a fused vitreous material that has the ageless beauty of glass. In building construction, the color side is mounted to the interior, thus providing the additional weather protection of a quarter-inch or more of glass. The product is non-porous, self-cleaning, non-absorbent, stain and odor proof.

REMMEY NAMES WEST COAST REPRESENTATIVE

Richard C. Remmey Son Company has announced the appointment of W. P. Keith Company as exclusive factory sales representative for the company on the West Coast.

The Keith organization will handle all Remmey products, including a new line of high-temperature Crystalite mullite refractories.

• Because of "substantially larger production at our recently completed new plant" and "ability to meet increasing demands for our cerium, other rare earths and thorium chemicals for a wide variety of industrial and chemical applications," Charles R. Lindsay, III, President and Chairman of the Board of Lindsay Chemical Company, has announced the appointment of C. Franklin Brown, Inc., advertising agency, to assist in launching its new sales and advertising campaign.

WYANDOTTE NAMES EASTERN SALES MANAGER

M. A. Thompson has been made Eastern Sales Manager for Wyandotte Chemicals Corporation's Michigan Alkali Division, according to a recent announcement.

Mr. Thompson, who will manage the company's New York office, is a veteran employee at Wyandotte. He joined the company in 1943 and previously managed offices at Detroit and Chicago. More recently, he has been Manager of Field Sales for the firm.

In his new capacity, Mr. Thompson becomes responsible for sales in Wyandotte's largest district office. He will supervise all sales activities in Eastern New York, New England, New Jersey, Virginia, North Carolina and Eastern Pennsylvania. He is a graduate of the University of Chicago School of Business.

DONNELLEY-KELLEY MAKES APPOINTMENT

John F. Donnelley, Vice President and General Manager of the Donnelley-Kelley Glass Company, has announced the appointment of Lieut. General Daniel Noce, Retired, formerly Inspector General of the Army, as Director of Engineering and Research for the Specialties Division.

Lieut. Gen. Noce graduated from West Point in 1917 and following service in World War I, continued his engineering studies at Massachusetts Institute of Technology, graduating in 1921. He is a former commander of Fort Belvoir and a former instructor in the Engineering College. In World War II, General Noce commanded, from its inception, the engineering amphibian command, was on the staff of Gen. Eisenhower at the time of the Normandy invasion and was later Deputy Commander of the Mediterranean Theater. From 1949 to 1952, he was Chief of Staff, European Command, with headquarters in Germany. He was Inspector General of the Army from 1953 until his retirement late last year.

General Noce will spend part of his time at the company's plant in Holland, Michigan, and the balance on research projects in Washington, D. C.

HOMMEL APPOINTS SALES REPRESENTATIVE

Ernest M. Hommel, President of The O. Hommel Company, has announced the appointment of William H. "Bill" Blair as sales representative in the Southwestern territory. He will make his headquarters in Dallas, Texas.

Mr. Blair attended the School of Business Administration, Ohio State University, for three years and is a graduate of the Cleveland School of Art. He was associated with several potteries, gaining experience in colors, methods of application, design and development. He also operated his own studio, designing artware and figurines. From 1946 to 1955, he was President and General Manager of Blair Ceramics.

. . . for Spraying, Squeegee, and Brush Application

HOMMEL GLASS COLORS assure satisfaction . . . the kind of satisfaction that gives you uninterrupted production . . . true uniform colors from shipment to shipment . . . HOMMEL Technicians will match any color to the most exacting specifications.

HOT SQUEEGEE PRINTING* Don't overlook this HOMMEL development that keeps screens clear and instantly dries the design on the glass. Write today for a HOMMEL representative to show you hot squeegee printing.

ACID RESISTING for table and laboratory glass ware.

ALKALI RESISTING brilliant and opaque qualities are retained after repeated washings in strong alkali solutions of beverage and milk bottles.

SULPHIDE RESISTANT unaffected by the toughest atmospheric conditions, a longer brilliant life for outdoor signs.

WRITE OR WIRE TODAY—We welcome the opportunity to show you how we can match your color requirements. We can help you produce better Glass Ware.

*PATENT APPLIED FOR

ICES a permanent crystalline finish of sparkling beauty.

GOLD Liquid Bright Golds, Brown Golds Powder, Paste Golds, Liquid Burnish Gold. Made to give maximum adherence and wearing qualities under your production conditions.

SQUEEGEE OIL Hommel squeegee oil has proved to be the best under all conditions . . . sharp prints . . . clear screens . . . stable colors . . . no bleeding no disagreeable odors. Write for samples.

EQUIPMENT Spray Guns — Brushes — Grinding Mills — Banding Wheels — Every Decorating Supply you need.

CHEMICALS Everything you use from the Batch Plant to the Decorating Lehr.

64 YEARS EXPERIENCE

SINCE 1891

"THE WORLD'S MOST COMPLETE CERAMIC SUPPLIER"

Equipment and Supplies • • •

(*Continued from page* 432)

nished in natural, anodized natural or in eight anodized decorator colors. Stylmark hardware is available in two types: picture frame style and channel frame style.

GLASS STRAIN VIEWER

Epic, Inc., 154 Nassau Street, New York 38, New York, has announced that it is the United States representative for the new Askania glass strain viewer which is manufactured by Askania-Werke, A.C. in the American Sector of Western Berlin.

The operation of the viewer is simple and any strain is made visible by just holding the object to be tested between the eyepiece and the light source. After switching on the lamp, a uniform red coloring of the entire field of view is observed through the observation head. A glass specimen with only minute strain will not show any changes of tint, while on the other hand, a strained specimen will show stripes of a distinctly different color. The more numerous the different color effects, the greater is the existing strain. Large and wide color stains would indicate less strain, while closely adjacent stripes of different colors point to greater strain.

CATALOGS RECEIVED

General Electric Company, Schenectady 5, New York, has made available a new bulletin on transformers for electric arc furnaces. The 12-page illustrated brochure features a comprehensive guide form to assist arc furnace users in preparing specifications for the transformers which will best serve their needs. The guide form lists all the optional features of the transformer which might be required for particular applications.

Two pages of the bulletin describe the construction and operation of the wedge-type tap changer used to obtain various values of output voltage and reactance. Another page tabulates weights, dimensions and cooling water requirements for furnace transformers in typical ratings from 750 to 15,000 kva, together with approximate low-voltage values at full and reduced capacity, and the total reactance.

The Babcock & Wilcox Company, Refractories Division, 161 East 42nd Street, New York 17, New York, is offering Bulletin R-34 entitled "B&W Firebrick."

The new bulletin lists and discusses properties and characteristics of B&W's Allmul, Allmul-D, 80, 80-D, and Junior Firebrick. Typical applications of these firebrick in a wide variety of industrial furnaces are discussed and graphically illustrated.

Helpful tables for estimating brick quantities for arches and circular linings are also included in the 28-page booklet. Cut-away illustrations are shown throughout.

Boulin Instrument Corporation, 65 Madison Avenue, New York, New York, has issued a new, 4-page folder describing the simplified operation and ease of installation of its stationary centrifugal tachometers.

The folder explains and illustrates how the design components of its tachometer are easily adaptable for quick installation on any type of plant operating equipment, such as conveyors, motors, etc., to check and show proper speeds for maintaining optimum performance.

Featured is a series of engineering drawings illustrating the interchangeable components, such as tachometer heads, different type drive sections, pinion bracket assemblies and split gear drives, together with specification details for individual user requirements. The folder suggests many applications for in-process speed control where absolute uniformity of processing is demanded.

Acoustica Associates, Inc. Shore Road, Glenwood Landing, Long Island, N. Y., has issued a new bulletin featuring Acoustica Model DR-400 ultrasonic cleaning equipment for production cleaning and degreasing of precision products for glassware, ceramics, the optical industries, etc.

Presented in the bulletin is a photograph of the unit, together with explanation of its above-audibility sound wave principle of operation and complete specifications of the model.

There's no end to the quality 'Finishes' possible with

STAUFFER BORATES

STAUFFER

BORAX · Anhydrous · Pentahydrate and Decahydrate

STAUFFER BORIC ACID · U.S.P. and Technical

Stauffer Borates are also supplied in bulk carloads!

The end is as good as the means employed—Ceramists recognize that Stauffer Borates are an excellent flux in enamel and glaze formulations, thus insuring high quality finishes. Stauffer Boric Acid is a key material for greater acid resistance.

Stauffer supplies Caustic Soda, Cream of Tartar, Potassium Nitrate, Sulphur, and Sulphuric Acid (various grades). Also available on the West Coast are Sodium Sulphates, Copperas, and Sodium Silico Fluoride.

STAUFFER CHEMICAL COMPANY

Stauffer CHEMICALS

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636 California Street
San Francisco 8, California

326 S. Main Street, Akron 8, Ohio

824 Wilshire Boulevard, Los Angeles 14, Calif.

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Have Fun...

Vacation time!

And where do vacations come from? They come from brick! Yes, refractory brick.

The brick that lines the furnaces of industry . . . contains their heat . . . produces the steel for that hook on the end of your line and the glass rod that holds it. Your waders, too.

Behind everything that's made lies refractory brick.

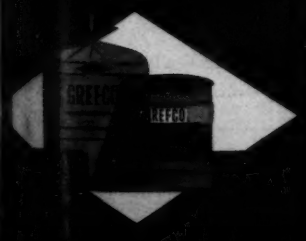
Making it calls for a multitude of skills and resources . . . mines, minerals, science, laboratory controls, research . . . and a vast system of distribution.

These are what General Refractories contribute to your happiness, your welfare, your daily life. Everywhere. Swiftly. Dependably. Economically.

GENERAL REFRACTORIES CO. PHILADELPHIA 2

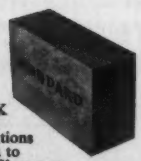
GENERAL REFRACTORIES

COMPLETE REFRACTORIES SERVICE



FOR THE GLASS INDUSTRY . . .

RITEX—Unburned basic brick—in magnesite, magnesite-chrome, and chrome-magnesite. More resistant to spalling. Lower porosity, lower thermal conductivity—high hot strength.



GREFCO SILICA BRICK are available at convenient locations from California to Pennsylvania. Glass men know there is no finer product. No more dependable supply.

OLIVE HILL—An exceptionally strong and dense fireclay brick—true to size and shape.

O-I PACIFIC COAST APPOINTMENTS

The promotion of two sales executives in the Pacific Coast Division of Owens-Illinois Glass Company have been announced by K. C. White, Vice President and Division General Manager.

Lee Richardson, now Seattle branch manager, was named Assistant to the General Sales Manager at San Francisco, and Robert Blowney, now assistant Seattle branch manager, succeeds Mr. Richardson.

Mr. Richardson joined Owens-Illinois in 1921 and was made branch manager at Seattle in 1934. Mr. Blowney started in the accounting department at Owens-Illinois' general office in Toledo in 1929 and was transferred to an administrative sales position in San Francisco in 1944. He was made Seattle assistant branch manager last January.

INFRARED BIBLIOGRAPHY

A 374-page bibliography on infrared radiation and its multitude of applications in science, technology and industry has been made available by the Office of Technical Service, U. S. Department of Commerce.

Compiled by the Library of Congress under Office of Naval Research contract, the bibliography includes all references to published literature on the subject from 1935 to 1951 which were found by systematic search of available sources.

The classification proceeds from infrared theory and general infrared-optical properties through the various elements and components of infrared equipment, infrared spectroscopy and photography, to its various applications in science, technology, the arts and industry.

The bibliography, PB 111643, may be ordered from the Office of Technical Service, U. S. Department of Commerce, Washington 25, D. C.; Price, $3.00.

• Some 30 contracts covering construction and equipment for Kaiser Aluminum & Chemical Corporation's new Columbiana, Ohio, basic refractory brick plant have been awarded by the company. Groundbreaking on the 160-acre plant site will take place within a few weeks, and is expected to be completed about mid-1956.

ERRATA: In the item on "Pressure-Controlled Hydraulic Balance," The Glass Industry, page 152, March 1955, it has been brought to our attention that the accuracy was stated as being within 0.0001°C. instead of 0.001°C.

• The Brockway Glass Company has been informed that its 1954 Annual Report to stockholders has received a Merit Award in the Fifteenth Annual Report Survey conducted by *Financial World*, the investment and business weekly.

• Kimble Glass Company, subsidiary of Owens-Illinois, was cited at the recent 87th Annual American Institute of Architects Convention for producing three outstanding glass block catalogs in 1954.

GLASS MELTING FURNACE CONSTRUCTION
OUR SPECIALITY
NEW FURNACES—REMODELING
HOT REPAIRS

WE WILL BE PLEASED TO QUOTE ON CONSTRUCTION WITHOUT OBLIGATION

TOLEDO ENGINEERING Company
PHONE-KLONDIKE 1529
DESIGNERS AND BUILDERS OF GLASS MELTING FURNACES
3001 SYLVANIA AVENUE, TOLEDO 13, OHIO

New Plant now in production taps natural source of sodium sulfate

West End Chemical Company now is producing Salt Cake and Anhydrous Sodium Sulfate at the rate of approximately 50,000 tons annually. These new products maintain the *premium quality* which has characterized West End Soda Ash and Borax for over 30 years. We proudly add Salt Cake and Anhydrous Sodium Sulfate to the list of industrial chemicals carrying the well-known West End brand.

WEST END
CHEMICAL COMPANY
SODA ASH • BORAX • SODIUM SULFATE
SALT CAKE • HYDRATED LIME

West End will be pleased to submit samples, prices and freight schedules for your evaluation upon receipt of your inquiry. We request that you include any applicable specifications governing your requirements for these products.

West End Chemical Co.

Executive Offices: Nineteen Fifty-Six Webster Bldg., Oakland 12, California · Plant: Westend, California

CORNING ANNOUNCES GLASCAST PROCESS

The development of a fast economical method for the precision casting of metals through use of glass molds has been announced by Corning Glass Works.

The Corning Glascast process, designed especially for work with high temperature alloys, assures an excellent surface finish and the tight dimensional control required in precision castings. The process eliminates the use of the precoat step in investment casting and the undesirable cracking and spalling which necessitates rejecting a high percentage of the castings.

Easy to use, Corning Glascast powder is essentially a 96 per cent pure silica glass which is mixed with water to produce a casting slip. Poured into a porous plaster form, the slip builds up into a Glascast shell which is dried, removed from the plaster and fired. The mold is then ready for use without further treatment.

The mold material has high chemical stability and does not react with the metal or its oxides to cause surface imperfections. Accurate control of grain size is thus possible even at metal pouring temperatures as high as 3200°F. Close dimensional control is assured because the vitreous Glascast powder has extremely low thermal expansion, avoiding the abrupt volumetric changes typical of foundry sands. Tolerance of ± 0.005 inch per inch can be readily obtained.

Glascast has good resistance to thermal shock and molds can be fired without danger of cracking (hot shells will not crack even when held under a stream of cold water). Definition may be held to 0.020 inch and the very low mold expansion enables accurate calculation of metal shrinkage.

16TH GLASS CONFERENCE

The Sixteenth Conference on Glass Problems will be held at the University of Illinois, Urbana, Illinois, on Thursday and Friday, December 1 and 2, 1955.

The program will be announced in early October. Any questions relating to the Conference should be directed to F. V. Tooley, Professor of Glass Technology, Department of Ceramic Engineering, University of Illinois, Urbana, Illinois.

HARBISON-WALKER TO BUILD PERU PLANT

Harbison-Walker Refractories Company has recently purchased a tract of land in Lima, Peru, on which a refractories plant for the production of fireclay, silica and basic refractories will be constructed immediately, according to an announcement by E. A. Garber, President.

Associated with Harbison-Walker in the project are Cerro de Pasco Corporation of New York and Lima, and Miguel Dammert Muelle of San Isidro, Peru. Harbison-Walker will have the majority interest in the new company which will be known as Refractarios Peruanos, S. A., and will supply the supervisory and technical management. The plant will be operated largely by Peruvian personnel.

The new operation will take care of all requirements of Peruvian industry, including the smelting of copper and other metals, and the manufacture of Portland cement, steel and glass. The plant layout is designed for expansion as the need arises.

SALES PROMOTION MANAGER APPOINTED BY KIMBLE GLASS

The appointment of Walter D. Plummer as Sales Promotion Manager of Kimble Glass Company, Owens-Illinois subsidiary, has been announced by E. Benson Dennis, Jr., Vice President and General Sales Manager. Mr. Plummer succeeds Harlan Hobbs, whose promotion to Vice President of Glasco Products Company, another Owens-Illinois subsidiary, was recently announced.

Mr. Plummer was first employed at the Clarion plant of Owens-Illinois in 1931. He was transferred to the general offices at Toledo in 1934, and held various sales and advertising positions before he was named regional merchandising manager in Chicago for the Glass Container Division in 1944.

Returning to Toledo in 1948, Mr. Plummer was appointed Assistant Merchandising Manager for the Glass Container Division, a position he held until his recent appointment.

DEPARTMENT OF COMMERCE REPORT ON GROUND CRYSTALS

An improved sphere generator for precision contouring of round quartz crystals on a mass production basis is described in a report just released to industry by the Office of Technical Services, U. S. Department of Commerce.

Developed by Bausch & Lomb Optical Company under Army Signal Corps contract, this contouring machine grinds spherical bevels on one or more flat round crystals at a time, with a range of curves from 29 mm. to 350 mm. Curves even shorter can be generated with slight modifications in the machine and its auxiliary equipment.

Details of the new design features are discussed in the report, and original and improved equipment may be compared in numerous photographic plates. A step-by-step description of the grinding process is given.

The Report PB 111609, "Contouring Equipment for Round Crystals," may be ordered from the Office of Technical Service, U. S. Department of Commerce, at the cost of $1.60.

BLUE RIDGE GLASS ANNOUNCES PROMOTIONS

Blue Ridge Glass Corporation has announced the appointment of three men as vice presidents and the reappointment of H. L. Ross as Assistant Secretary and Controller.

The new vice presidents are S. S. Benedict, T. W. Glynn and J. E. Rigby. Their positions with the company are, respectively, Director of Industrial and Public Relations, Director of Mechanical and Product Development, and Chief Engineer. Mr. Rigby has been with the company since 1927, Mr. Benedict and Mr. Glynn since 1928.

stimulate the URGE TO BUY (your product)

with *Applied Color* (fired-on) *Labels*

add NEW COLOR beauty to your product

If you feel that an "everyday" product like yours can't be brought to life, think of the man who was the first to glamourize a glass of peanut butter. He really had a job . . . and it took the eye-catching brilliance of Applied Color Labels to give it shelf appeal.

Now, eye-appealing fired-on labels—easily applied at low cost—are within easy reach of every manufacturer of food and household products for daily consumption. Cash in on the fact that the woman shopper associates *better quality* with distinctive packaging. Switch to Applied Color Labels and watch your sales volume jump.

Discuss Applied Color Labels with your glass supplier or get in touch with Pemco for informative data on latest developments.

PEMCO CORPORATION • BALTIMORE 24, MARYLAND

HOT OIL COLORS • COLD COLORS • SCREENING PASTES
SATIN ETCH • COLORS • GLAZE FRITS • PORCELAIN ENAMEL FRITS

GLASS PACKER—June 1955

You benefit too! Advertisements like this urge your glass container customers to see you about the amazing sales-getting potential of Applied Color Labels. Recent developments in fired-on labels make possible greater package appeal—wider range of design—brighter, more permanent colors . . . at far less cost than before.

Do you know about these new developments—fully? You can get the latest information from Pemco—direct—or from the Pemco Sales Engineer in your territory. Write for "Glass Colors by Pemco" with Technical Supplement.

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Hydrazine • • •

(*Continued from page* 416)

Galla, Benj.
Private communication
Hepburn, J. R. I.
"Metallization of Plastics," p. 31, 1947
Jour. Electrodepos. Tech. Soc. Vol. 17, p. 1, 1941
Met. Ind. (London), Vol. 59, p. 90, 1941
Chem. Abst. Vol. 35, p. 7266, 1941
Heritage, R. J. & Balmer, J. R.
Metallurgia, Vol. 47, p. 171, 1952
James, T. H.
Jour. American Chem. Soc. Vol. 61, p. 2379, 1939
Jour. American Chem. Soc. Vol. 62, p. 536, 1649, 1654, 3411, 1940
Jour. Phys. Chem. Vol. 44, p. 42, 1940
Marino, O.
U. S. Pat. #1,096,177 May 12, 1914
Mason, R. B.
U. S. Pat. #1,988,012 Jan. 15, 1935
Chem. Abst. Vol. 29, p. 1380, 1935
Mathieson Chemical Corp.
now known as Olin-Mathieson Chemical Corp.
Baltimore, Md.
Metalectro Corp.
Avondale Farms, Laurel, Md.
Milton, C. L; Cort, I; Nielson, C. A. & Cowan, I.
Private communication
Morgan, R. & Myers, R. D.
Jour. Franklin Inst. Vol. 246, p. 363, 1948
Olin-Mathieson Chem. Corp.
Baltimore, Md.
Peacock, Jr; Wm.
French Pat. #847,148 Oct. 4, 1939
Chem. Abst. Vol. 35, p. 5664, 1941
Brit. Pat. #524,753 Aug. 14, 1940
Chem. Abst. Vol. 35, p. 6755, 1941
U. S. Pat. #2,214, 476 Sept. 10, 1941
Chem. Abst. Vol. 35, p. 867, 1941
Rohn & Haas Co.
Washington Square, Phila. Penna.
Silverman, A. & Neckerman, P. D.
Trans. American Ceram. Soc. Vol. 17, p. 505, 1915
Chem. Abst. Vol. 10, p. 672, 1916
Trevail, C. A. & Gladney, K. P.
U. S. Pat. #2,367,903 Jan. 23, 1945
Canadian Pat. #425,446 Feb. 6, 1945
Chem. Abst. Vol. 39, p. 1744, 3644, 1945
Upton, P. G. P. & Herrington, E. F. G.
Chem Age, Vol. 63, p. 14, 1950
Research (London), Vol. 3, p. 289, 1950
Chem. Abst. Vol. 41, p. 5034, 1947
Chem. Abst. Vol. 44, p. 8800, 1950
Watt, G. W.
Chem. Rev. Vol. 36, p. 289, 317, 1950
Welsh, T. W. B.
Jour. American Chem. Soc. Vol. 37, p. 497, 1915
Welsh, T. W. B. & Broderson, H. J.
Jour. American Chem. Soc. Vol. 37, p. 816, 825, 1915

PPG PLANTS RECEIVE SAFETY AWARD

Two Glass Division units of the Pittsburgh Plate Glass Company have been cited by the National Safety Council to receive its highest safety award, the "Award of Honor," for their outstanding safety records during 1954, it was announced by T. R. Donoghue, Manager of Safety and Plant Protection for the firm. Both plate glassmaking operations, Works Four and Works Six, are located at Ford City, Pa.

Employees of Works Six were recognized by the Council for completing last year without a lost-time accident which enabled them to increase their accident-free man-hours total to 2,256,414 since the plant's last disabling injury on August 5, 1953.

BASIC SALES MANAGER NAMED FOR HARBISON-WALKER

Frank P. Shonkwiler has been named Manager of Basic Sales by Harbison-Walker Refractories Company. He formerly was a member of the Chicago District Sales Staff. His headquarters now will be in Pittsburgh.

Mr. Shonkwiler started with Harbison-Walker in the Research Department in 1943. In 1952, he transferred from research to sales work, being assigned to the Chicago District. Mr. Shonkwiler is a ceramic engineering graduate of the University of Illinois.

Glassmakers Prefer

SOLVAY Potassium Carbonate

Because...

...It's the ONE Potassium Carbonate That is

• COMPLETELY DUSTLESS!
• UNIFORM IN GRANULAR SIZE!

Available in 2 Forms:

DUSTLESS CALCINED IS 99-100% K_2CO_3

GRANULAR HYDRATED IS 83-85% K_2CO_3

Other Solvay Products for the Glass Industry:

AMMONIUM BICARBONATE
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Soda Ash • Snowflake® Crystals • Potassium Carbonate • Calcium Chloride
Sodium Bicarbonate • Ammonium Bicarbonate • Caustic Potash • Chloroform
Cleaning Compounds • Sodium Nitrite • Ammonium Chloride • Methyl Chloride
Monochlorobenzene • Para-dichlorobenzene • Methylene Chloride • Chlorine
Caustic Soda • Ortho-dichlorobenzene • Carbon Tetrachloride

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BRANCH SALES OFFICES:
Boston • Charlotte • Chicago • Cincinnati • Cleveland • Detroit • Houston
New Orleans • New York • Philadelphia • Pittsburgh • St. Louis • Syracuse

109,423 tons of flint glass *without feathering*

"You can be proud of this performance", says glass plant general manager

Furnace: Cross-fired; regenerative
Type of glass: Soda lime flint
Area of melting end: 700 sq. ft.
Total operating days: 1,038
Total tons melted: 109,423
Average tons per operating day: 105.4
Tons per sq. ft. of melting end for entire campaign: 156.3
Average rate of pull, sq. ft./ton: 6.64
Maximum rate of pull, sq. ft./ton: 5.70
Minimum rate of pull, sq. ft./ton: 8.50
Furnace depth: 42 inches
Fuel used: Natural gas

That's the kind of service you expect with Laclede-Christy 12-inch CAST 400 Bottom Blocks

The campaign that produced 109,423 tons of soda lime flint glass covered 35 months and 3 days. It happened in northern California. And, it's only one of similar records reported throughout the country.

Laclede-Christy 12-inch Cast 400 bottom blocks used measured 4¼ in. to 8¼ in. thick *at the joints*—after 1038 operating days. No glass feathering occurred through the bottom joints.

This data tends to prove one point: You certainly get your money's worth *and more* when you use Laclede-Christy Refractories. The "quality-first" symbol proves itself on the job—as it will for years and years to come. Why use any refractories other than Laclede-Christy?

LACLEDE-CHRISTY COMPANY

DIVISION OF H. K. PORTER COMPANY, INC.

2000 Hampton Avenue · St. Louis 10, Missouri
Mission 7-2400

Inaugurating a new era of service to the industrial heating industry

Glass Conference Summaries • • •

(*Continued from page* 420)

pending upon how rapidly it has been cooled or, in other words, depending upon how much time it has had in which to try to reach a condition of equilibrium. When such glass is reheated, it may take hours, days or even years (depending upon temperature) to remove the effects of this frozen-in condition. Littleton found that when a lime glass fiber was chilled rapidly from high temperature to room temperature and then rapidly reheated to 460°C., the initial viscosity was log $N_o = 14$. After 3000 minutes at a constant temperature of 460°C., the viscosity had increased to log $N_t = 15.5$, and it appeared that after a very long time, it would approach the equilibrium value marked at log $N_e = 16$.

At this time, the final viscosity would be 100 times greater than the initial value. Lillie used fibers of the same glass, heated them to about 800°C. and then chilled them by dropping them in a quenching bath at 440°C. He found the viscosity at 453°C. increased from log $N_o = 15.1$ to log $N_t = 16.5$. This required 10,000 minutes and at the end of that time, the viscosity was still increasing fairly rapidly. Consequently, the equilibrium value may well be plotted at log $N_e = 17.0$ or even higher.

Tool introduced the concept of a "fictive" temperature Θ. Suppose a piece of glass is at actual temperature T, but has been cooled to T from some temperature much higher than T at a rate too great to allow the glass to attain its equilibrium conditions at each intermediate temperature during cooling. Then this glass will behave as though it had the characteristics of some higher temperature, and this is called the fictive temperature. Tool points out that if the cooling is very rapid from the temperatures well above the annealing range, Θ is very high when atmospheric temperatures are reached, whereas if the cooling is very slow, φ may be 70 to 90°C. below the (usual) annealing point. We thus get minimum and maximum viscosity curves.

Using these concepts, Lillie performed a series of experiments which proved conclusively that the equation

$$\frac{dF}{dt} = -MF\varphi \qquad (2)$$

is a true and complete representation of the stress release phenomena. The constant M was found to be essentially independent of temperature and thermal history, representing some unknown modulus of the particular glass. The thermal history effects, of course, were represented by the changing values of the fluidity φ with time. The early relationship of Adams and Williamson, while theoretically wrong, is empirically right in most cases since there is a definite correlation between stress release and viscosity (or fluidity) during any single annealing run. However, the greatest care must be used in applying their formula to unusual conditions, such as in the case of glass which has already been once annealed, or has been highly tempered.

Black's "full temper" required a degree of chilling so rapid that a higher temperature state is "frozen" in the glass. To fix the initial viscosity curve more accurately, the investigator must appeal to the experimental results themselves since there are no direct viscosity measurements on the tempered samples. For example, by considering the stress release at the usual strain point (517°C.), the investigator can establish 493°C. as a roughly equivalent temperature for the tempered glass.

The generality of the empirical equation developed here will be extended if it can be shown to apply to the pioneering data of Littleton and Lillie. Their stress release data were expressed in terms of birefringence (mu/cm) and the published graphs are so small that accurate reproduction is difficult. The data at 460°C. are quite well represented by:

$$\text{Log } \delta = 3.3 - .935 \log (.36t + 1)$$

Where δ = birefringence (mu/cm). If this be converted to actual stress in kg./mm², for comparison with other equations in this report, we have

$$\text{Log } F = 0.9 - .935 \log (.36t + 1)$$

It would be extremely interesting, from a theoretical point of view, to extend this kind of work in several directions: (1) by exposing each sample for one length of time only, (2) by gathering comparative data on fibers of the same glass, with simultaneous measurement of the viscosities at each time, (3) by varying the initial degree of temper and the reheating rate, (4) by determining how accurately certain equations fit the (a) long-time data of Morey on Pyrex brand glass and (b) original data of Adams and Williamson, (5) by establishing, with this additional evidence the true meaning of K and A, on the basis of the present picture of the atomic structure of glass.

Research Digest • • •

(*Continued from page* 428)

no regeneration of the producer gas. (d) The fullest possible use was to be made of insulation on the crown, jamb walls, ports and regenerators. (e) A waste-heat boiler, besides being desirable for its own sake, was practically essential. Apart from turning to excellent use otherwise wasted heat, it would provide the higher draft required for cross-flow regenerators. (f) A water-sealed air valve was included as a most necessary adjunct to the waste-heat boiler.

The furnace particulars are given in Table 1.

The furnace started in February 1949 and the results of the first five years of operation are as follows: The first life was 71 weeks, and 19,800 tons of glass were melted (57 tons per sq. ft. of melting area). Operating results were considered entirely satisfactory. After 8 months, one of the ports began to give trouble, the silica mid-feather collapsing. This was the main cause of the furnace going down as the port became so blocked up with silica brick that melting was reduced to 8 sq. ft. per ton, and this was considered not good enough for the production required.

The second life was 78 weeks, during which 27,000 tons were melted (77 tons per sq. ft. melting area). After about a year, some superstructure trouble developed. The tuckstones in one of the bridgewall corners of the furnace gave way allowing the jamb wall to open up and become badly burnt. This was the main cause of the second shutdown.

In both runs, sillimanite flux blocks were mainly used and clay blocks in the lower course and bottom. At no time did any of the blocks look like being the cause of any serious trouble. But in the light of the results obtained, Corhart Standard and Corhart Zac were introduced, for the third life, at what seemed to be the

Table 2.
Efficiency and "Performance" Data. Worksop Furnace

Period	Age (Mos.)	Glass Melted (Tons/ Week)	Coal (Tons/ Week)	Glass/ Coal	Eff. %	"Per-form-ance" Q	Melting Area (Sq. ft./ ton/ 24 hr.)
First Run—February 1949 to July 1950							
June 1949 (5 wks)	4	255	95.0	2.67	24.0	4.18	9.5
Oct.-Nov. 1949 (8 wks)	9	301	99.4	3.03	27.3	3.94	8.0
Whole life (71 wks)		250	95.0	2.63	23.7	4.23	9.7
Totals:		17,785	6744				
Second Run—August 1950 to February 1952							
Sept.-Oct. 1950 (7 wks)	1	339	103.2	3.30	29.7	3.76	7.15
Whole life (78 wks)		309	103.0	3.00	27.0	4.13	7.9
Totals:		24,111	8031				
Third Run—March 1952 to April 1954							
Nov.-Dec. 1952 (7 wks)	9	323	110.4	2.93	26.4	4.52	7.6
Mar. 1952—Jan. 1954 (95 wks)		260	99.1	2.62	23.6	4.44	9.4
Totals:		24,670	9412				

most vulnerable parts of the tank. A sillimanite bottom was installed and a simple modification was made to the arrangement of the tuckstones and superstructure at the corner where trouble had developed. The third life was 120 weeks, during which 31,500 tons of glass were melted (91 tons/sq. ft. melting area). The furnace was put down solely for production reasons.

Table 2 gives particulars of the performances during each of the three lives of the furnace. A point of interest noticed only when the table had been completed is the apparent falling off of efficiency, as judged by "performance," during the third life. It is suggested that this could be due to a number of factors: (a) the use of more electro-cast refractories; (b) the gradual deterioration of brickwork and insulation resulting in increased leakage and wall-heat losses; (c) a water leak on the gas producer which was not discovered for a long time; (d) a patch of crown insulation had to be taken off because of a small leak.

Throughout the whole of the five years, the waste-heat boiler has given excellent service, free from trouble and worry. No auxiliary firing has ever been used.

GROUND-BREAKING FOR OWENS-ILLINOIS PORTLAND PLANT

Ground-breaking ceremonies for Portland, Oregon's Owens-Illinois glass container plant were held July 12, with Governor Paul L. Patterson, Mayor Fred L. Peterson, and other city officials and company representatives in attendance.

Following remarks by the Governor and Mayor, 1955 Portland Rose Queen, Nancy Wyly, representing the Northwest, turned the first shovelful of earth marking the start of construction of the glass container plant due to be completed in August 1956.

DIAMOND ALKALI PUERTO RICO SUBSIDIARY

Formation of Diamond Chemicals of Puerto Rico, Inc. has been announced by Diamond Alkali Company. The new firm will operate as a subsidiary of Diamond Alkali, with Miles H. Fairban, Inc., Puerto Rico, holding a minority interest.

Scheduled to begin operations about August 15, the company will formulate an expanding line of detergents and cleaning compounds.

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Inventions and Inventors • • •

(*Continued from page 427*)

with a set screw and thus attached to sleeve 25. For convenience in placing the tube 28 accurately in the conveyor, there is provided a reciprocating stop plate to the left of the conveyor. This plate is reciprocated via a Bowden cable. In a machine with 8 positions, 500 tubes can be end-shaped per hour, the machine being operated by one man only.

The patent contains 28 claims and 12 references were cited.

Miscellaneous Processes

Glass Forming. Fig. 5. Patent No. 2,696,699. Filed February 8, 1952. Issued December 14, 1954. One sheet of drawings. Assigned to Corning Glass Works by James W. Giffen.

The present invention relates to the fabrication of tubulated glass articles, such as funnel tubes and television tube blanks of funnel-tube configuration. In accordance with Fig. 5, there is arranged on distributor shaft 18, between two fixed collars 21 and 22, a sizing tool 23 resiliently held against collar 21 by a spring 24. The location of collar 21 is such that it permits tool 23 to be brought near enough to the oppositely disposed mold wall surface to engage the inner wall surface of a funnel tube 25 in the area of funnel-tubulation juncture under compression of the spring 24 as the distributor 17 approaches its lowermost position within the bore of mold portion 12. Tool 23 is thereby enabled to press the glass in such area to limit its thickness to that which assures that a television picture tube made from the resulting funnel tube will have the required beam clearance tolerance. With this arrangement, since the shaft 18 is rotatably supported, the tool 23 carried thus rotates with the centrifugally spinning glass so that the funnel-tubulation junction wall area is pressed solely by vertically applied pressure.

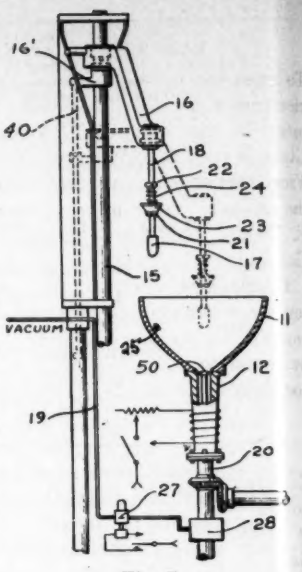

Fig. 5

The patent contains 18 claims and the following references were cited: 960,587, Sanford, June 7, 1910; 1,721,983, Bailey, July 23, 1929; 1,859,957, Canfield, May 24, 1932; 2,198,750, Winder, Apr. 30, 1940; 2,374,269, Breadner et al., Apr. 24, 1945; 2,475,915, Orr, July 12, 1949; 23,348-29, Australia, Oct. 20, 1930; and 566,519, Great Britain, Jan. 2, 1945.

• Lynch Corporation has expanded abroad by acquiring 100 per cent of the stock of Lynch International Ltd., British subsidiary, it has been announced by Thomas C. Werbe, Jr., Executive Vice President.

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CORNING ESTABLISHES ELECTRONICS DEPARTMENT

To meet the increasing demands of the rapidly growing electronics industry, the establishment of a new department in the Electrical Products Division of Corning Glass Works has been announced by John L. Hanigan, Vice President and Division Manager. To be known as the Components Department, it will be headed by Forrest E. Behm, formerly Manager of Pressware Plant in Corning.

In his new capacity, Mr. Behm will be responsible for the manufacture and sales of various types of glass components, some of which are now being used in volume by manufacturers of radio and television sets and other commercial electronic equipment.

O-I BUILDING TWO WAREHOUSES

Construction is underway on two glass container warehouses which will nearly double the warehouse capacity at Owens-Illinois Glass Company's Clarion, Pa., and Gas City, Indiana, plants.

The Clarion warehouse is scheduled for completion December 1 and the Gas City warehouse is expected to be ready by December 15.

• Construction work on Pittsburgh Plate Glass Company's plate glass plant at Cumberland, Maryland, was expected to get underway shortly after July 1, according to Harry D. Higgins, President. Ground was broken on the plant site last September.

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• The Brockway Glass Company has announced the appointment of E. C. Faust and G. R. Hollen as assistants to the general sales manager. Both Mr. Faust and Mr. Hollen will continue their present duties in the Planning and Control Division.

• Foxboro Corporation has named Yokogawa Electric Works, Ltd., Tokyo, Japan, to manufacture and sell the full Foxboro line, as well as its own electrical strip chart instruments, according to B. H. Bristol, President of Foxboro.

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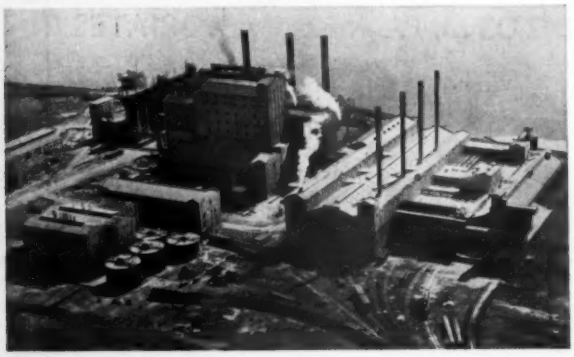
Milestones in Glass Progress

PHOTO COURTESY THE CORNING MUSEUM OF GLASS

1676 George Ravenscroft, English glassmaker, revolutionized glassmaking by discovering lead crystal. To this day, fine glass is made from a variation of his early formula. As a result of his discovery, Ravenscroft was permitted by the government to mark his glass with the raven seal taken from his own coat of arms. Above is one of only two known goblets bearing his seal.



1890 Michigan Alkali Company, now a division of Wyandotte Chemicals Corporation (North Plant, above), was founded by Captain J. B. Ford to supply Soda Ash to the glass industry. Wyandotte has grown up with glass. Today, as in the past, it is a working partner, supplying technical assistance and raw-material chemicals to those great companies marking milestones in glass progress.

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